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**Understanding the impact of psychosocial risk factors on the  
maternal-fetal/infant relationship in the perinatal period**

**Imogen Charlotte Marsh**

**Doctorate in Clinical Psychology**

**The University of Edinburgh**

**2019**

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## **Dedication**

In loving memory of Olive Jean Batty.

\*

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## Lay Summary

This thesis, entitled *Understanding the impact of psychosocial risk factors on the maternal-fetal/infant relationship in the perinatal period*, is made up of two parts. The first is a systematic review (*Maternal substance misuse and the maternal-fetal/infant relationship: A systematic review and narrative synthesis*), and the second is a report of an original research study (*Thinking about your baby: maternal caregiving representations, maternal-fetal relationship quality, and psychosocial risk factors in the second trimester of pregnancy*).

The systematic review summarises findings from 15 studies conducted between 1990 and 2014. All of the studies included women with current or historical substance misuse difficulties. In this thesis substance misuse is defined as using illicit drugs, or using licit substances such as alcohol, tobacco, and prescription medication in a way not recommended by doctors. All of the studies reported data regarding how women thought and felt about their babies whilst pregnant, and in the first year after giving birth (referred to together as the 'perinatal period'). How women think and feel about their unborn babies is thought to reflect the quality of the maternal-fetal relationship. The type of maternal-fetal relationship a woman has is known to predict the type of relationship she will have with her baby after birth (the maternal-infant relationship). The maternal-infant relationship is made up of how a mother thinks and feels about her baby, and also how she and the baby interact, which in turn predicts how healthy and happy a child will tend to be across his or her lifetime.

The purpose of the systematic review was to find out whether or not all the existing research to date suggested that women with substance misuse difficulties had less positive relationships with their babies in the perinatal period, and thus might need more support during pregnancy and in the year after birth to develop positive maternal-fetal/infant relationship. We found that the results of the 15 studies do not all tell the same story – some studies indicate that women with substance misuse difficulties have poorer maternal-fetal/infant relationship quality than comparison women, but others found no difference at all. What did become clear was that women with substance misuse difficulties tended to have more stressful lives overall – they were poorer, had received less education, did not have as much social support, and were more likely to be from a minority ethnic group. Some studies also suggested that substance misusing women were more likely to have experienced abuse and mental health difficulties. All of these factors are thought to be related to poorer

maternal-fetal/infant relationship quality. Overall these findings suggest that whilst maternal substance misuse difficulties may be associated with poorer maternal-fetal/infant relationship quality, the real danger comes from a mother and her baby experiencing a lot of these risk factors at once. This means that when health and social care professionals want to support women with substance misuse difficulties to have better relationships with their babies, they will have to think about not just helping them with their substance misuse, but also their housing, social support, physical safety, and their psychological wellbeing. Another main conclusion of this review is that there needs to be more – and better quality – research looking at how all these factors link together, so that professionals and services can better understand how to provide help and support to vulnerable women and their babies, to give them the best start in their life together.

The original research study looked specifically at how two aspects of maternal-fetal relationship quality related to each other: whether how a woman *thinks* about her baby is related to how she *feels* about her baby during pregnancy. We also looked at whether some of the psychosocial factors highlighted in the systematic review (e.g., experience of abuse, depression, style of relating to other people, level of education, employment status) were linked to how pregnant women thought and felt about their babies. One hundred and seventy-two women from the general public who were in the second trimester of their pregnancy (13 – 28 weeks pregnant) took part in the *Thinking about your baby* study by completing a set of online questionnaires.

One of the key findings was that the way in which women *think* about their babies in pregnancy predicts how they *feel* about their babies. Another key finding was that if a woman had an ‘avoidant’ style of relating to other people (e.g., not liking to get too emotionally close to others), this predicted a poorer emotional bond with her unborn baby, and this relationship was mediated by the ‘disorganised’ way in which she thought about her baby. This means that when a woman has an avoidant way of relating to other people, she is also more likely to think in a disorganised way about her baby, and this way of thinking about her baby mostly explains the way she feels about her baby. Findings also suggested that this link between maternal avoidance and a poorer emotional bond with the unborn baby may be weakened in cases where a woman has a more ‘secure organised’ way of thinking about her baby. Importantly, women who have experienced more psychosocial risk factors (e.g., having experienced physical or sexual abuse, reduced social support available, difficult

experiences in close relationships, and mental health difficulties) are more likely to have an avoidant relational style. This means that women who experience psychosocial risks may be especially vulnerable to developing a poor emotional bond with their unborn babies.

The findings of the *Thinking about your baby* study show that a range of psychosocial risk factors are linked to how women think and feel about their babies in pregnancy (maternal-fetal relationship quality). We know from other research that maternal-fetal relationship quality is linked to postnatal mother infant relationship quality and longer-term health and wellbeing outcomes for the child. Importantly, we found that this was the case in a sample of mostly well-educated White women who were in employment, a minority of whom reported clinically significant symptoms of depression and experience of abuse across their lifetime. Our findings suggest that women living in the context of greater psychosocial stressors such as poverty, unemployment, poor education, ethnic minority status, poor social support, interpersonal violence, and significant mental health and substance misuse difficulties may be at even greater risk of developing poor maternal-fetal relationship quality, which may have a long-term negative impact on their child's health and wellbeing across their lifespan. We conclude that being able to screen for how a woman is thinking about her baby in pregnancy may be a useful way to identify women who may benefit from extra support to develop a positive maternal-fetal relationship, perhaps by encouraging them to think about their babies in a 'secure organised' way.



## Thesis Abstract

**Background:** Maternal-fetal relationship quality is a known predictor of maternal-infant relationship quality. Maternal-infant relationship quality is associated with infant attachment style, and both are predictive of long-term physical and mental health and developmental outcomes. Maternal-fetal/infant relationship quality is known to be influenced by psychosocial factors such as maternal mental health, social support, and socio-economic status. The systematic review component of this thesis aimed to synthesise and evaluate existing research regarding the relationships between maternal-fetal/infant relationship and maternal substance misuse, to ascertain whether women with substance misuse difficulties are at risk of developing poorer quality maternal-fetal/infant relationships. The empirical research component of this thesis aimed to better understand the relationships between the cognitive (maternal caregiving representations) and affective aspects of maternal-fetal relationship quality, within the context of a range of psychosocial risk factors.

**Method:** The systematic review identified 15 studies reporting outcomes pertaining to maternal-fetal/infant relationship quality within the perinatal period (pregnancy and the first year postpartum) in the context of current/historical maternal substance misuse. The cross-sectional research study recruited  $n = 172$  women in the second trimester of pregnancy from the general population. Participants completed a range of self-report questionnaires regarding demographic factors, caregiving representations, affective quality of the maternal-fetal relationship, psychosocial risk, alcohol and substance misuse, depressive symptoms, and adult attachment style.

**Results:** The findings of the systematic review suggest that, rather than substance misuse being a unique risk factor, women who misuse substances might be at greater risk of developing poor maternal-fetal/infant relationship quality because of their increased likelihood of experiencing a constellation of inter-related psychosocial risk factors such as mental health difficulties, experience of interpersonal trauma, poor social support, low socio-economic status, and low educational attainment. The review highlighted the paucity of research regarding the adversities faced by women with current or historical substance misuse difficulties within the perinatal period. The findings of the original research study indicated that the quality of caregiving representations (how a woman thinks about her fetus) is significantly predictive of the quality of her affect towards her unborn child. Disorganised and secure organised

caregiving representations were found to mediate the significant relationship between maternal avoidant attachment style maternal-fetal affect.

**Conclusion:** Greater efforts are required to understand the impact of psychosocial risks on maternal-fetal/infant relationship quality, particularly for women experiencing multiple adversities. Caregiving representations are highlighted as a possible method of screening for risk of poor maternal-fetal/infant relationship quality, and as a potential point of intervention.

## Table of abbreviations

Abbreviation	Explanation
SM	Substance misuse; substance misusing; substance misuser
MIR	Maternal-infant relationship
MFR	Maternal-fetal relationship
MFAS	Maternal-Fetal Attachment Scale
PI	Pregnancy Interview

## **Systematic Review**

**Title:** Maternal substance misuse and the maternal-fetal/infant relationship: A systematic review and narrative synthesis<sup>1</sup>

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This review was completed as part of a Doctorate in Clinical Psychology with the University of Edinburgh and NHS Lanarkshire.

<sup>1</sup>Produced in line with author guidance for the Infant Mental Health Journal (see Appendix A, pp.148-149). Some additional materials, including tables and figures, may be found in Appendix B (pp.150-160).

<sup>2</sup>Field supervisor; <sup>3</sup>academic supervisor.

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## **Abstract**

Maternal misuse of licit and illicit substances during the perinatal period has been associated with poorer maternal-fetal and maternal-infant relationship quality, elevated maternal psychosocial risk factors, and impaired infant health and developmental outcomes. This systematic review synthesises the existing literature reporting associations between maternal substance misuse, maternal-fetal and maternal-infant relationship quality during the perinatal period, a range of maternal psychosocial covariates, and infant health/developmental outcomes. Sources of methodological bias are also assessed. This systematic review was conducted using PRISMA Criteria, searching EMBASE, Medline, PsycINFO, ProQuest Dissertations and Theses Global, and Google Scholar. Reference lists of the included papers were also searched. Fifteen studies were identified for inclusion. Findings suggest that maternal substance misuse occurs within a constellation of psychosocial risk factors associated with impaired maternal-fetal/infant relationship and poorer infant health/developmental outcomes. There was high heterogeneity between studies' research design, maternal-fetal/infant relationship measures, definition of substance misuse, and maternal characteristics. Risk of bias rating identified moderate to high risk of bias in all but one study. Current data suggests that the cumulative effect of a number of maternal psychosocial risk factors negatively influences maternal-fetal and maternal-infant relationship quality, which is likely to pose a risk to optimal infant health and development. The perinatal period represents an important point of intervention to address intergenerational transmission of risk and vulnerability in the context of maternal substance misuse and related psychosocial risk factors.

**Keywords:** maternal-fetal relationship; maternal-infant relationship; substance misuse; psychosocial risk; perinatal mental health.

## Introduction

Substance misuse (SM; use of illicit drugs and/or use of licit substances with greater frequency and/or in greater quantities than recommended) is a significant worldwide health risk (Peacock et al., 2018) with substantial socio-economic burden to society (Barrio, Reynolds, García-altés, Gual, & Anderson, 2017). SM is a considerable problem across the UK (Crawford, Gohel, Heneghan, Thomson, & Wright, 2016; Scottish Parliament Information Centre, 2017). Misuse of cannabis, cocaine, heroin, new psychoactive substances, alcohol, and tobacco is associated with a range of adverse physical and mental health outcomes (Butler, Rehm, & Fischer, 2017; Grella & Lovinger, 2011; Hall & Degenhardt, 2009; Manchester, Lomas, Waters, Dempsey, & Maskell, 2018; WHO & Management of Substance Abuse Team, 2018), including anxiety, depression, and post-traumatic stress disorder (Jacobsen, Southwick, & Kosten, 2001). Experience of physical and sexual abuse in childhood are significantly associated with SM in adolescence and adulthood (Simpson & Miller, 2002). Some social groups are at greater risk of SM related harm: significant covariates of the impact of SM on health include age, gender, and socio-economic status (SES; Katikireddi et al. 2017; WHO & Substance Abuse Team, 2018).

### *SM in the perinatal period*

Misuse of licit substances (e.g., alcohol and tobacco) in the perinatal period is known to have significant adverse consequences for mother and fetus. Prenatal alcohol exposure has significant negative effects on fetal physical and neural development (Caputo, Wood, & Jabbour, 2016), and increases risk of Fetal Alcohol Spectrum Disorder (Popova, Lange, Probst, Gmel, & Rehm, 2017), poorer intellectual outcomes (Khoury, Milligan, & Girard, 2015), internalising/externalising difficulties in childhood (Tsang, Lucas, Carmichael Olson, Pinto, & Elliott, 2016), greater negative affect, and fewer affiliation behaviours in the first two years of life (Schoeps et al., 2018). There appears to be a dose effect for the long-term negative outcomes for prenatally exposed infants (Tsang, Lucas, Carmichael Olson, Pinto, & Elliott, 2016). Some negative effects of prenatal alcohol exposure may be indirect: even slight increases in infant temperamental 'difficultness' is associated with reduced caregiver efficacy and increased dyadic conflict (Schoeps et al., 2018), which is in turn associated with poorer maternal-infant relationship (MIR) quality and other psychosocial developmental difficulties (Maria et al., 2017). Like alcohol consumption, smoking

tobacco is associated with negative health outcomes for pregnant women and offspring (Akerman et al., 2015), such as low infant birth weight, and sudden infant death (Andres & Day, 2000; Quesada et al., 2012). However, smoking tobacco is highly correlated with other maternal SM, making it difficult to isolate the effect of tobacco exposure on the fetus (Akerman et al., 2015).

Misuse of illicit substances in the perinatal period is detrimental to the health and development of mother and fetus, but the precise pattern of risk is variable. Cannabis is the most commonly used illicit drug in the UK, followed by cocaine and opioids (Scottish Parliament Information Centre, 2017). Cannabis use during pregnancy is associated with maternal anaemia, lower infant birth weight, and specialist care within neonatal infant care units (Gunn et al., 2016). Prenatal cocaine exposure is significantly associated with preterm delivery and low birthweight (Gouin, Murphy, & Shah, 2011), and has been associated with lower weight, height, and head circumference at 10 years of age, as well as greater self-reported depression (Wilcox & Hirshkowitz, 2015), and sustained attention and self-regulation difficulties (Ackerman, Riggins, & Black, 2010). Notably, studies report that environmental variables such as exposure to violence, continued maternal SM, and deprivation are significant mediators and moderators of the relationship between prenatal cocaine exposure and child developmental outcomes (Ackerman, Riggins, & Black, 2010; Richardson, Goldschmidt, Larkby, & Day, 2013). Prenatal opioid exposure may precipitate development of neonatal abstinence syndrome (NAS; McCarthy, Leamon, Finnegan, & Fassbender, 2016), itself associated with physical ill health, poor development, and infant irritability (Bagley, Wachman, Holland, & Brogly, 2014; Zedler et al., 2016). However, findings regarding the long-term impact on child physical, cognitive, and psychosocial development as a result of prenatal opioid exposure are heterogeneous (Baldacchino, Arbuckle, Petrie, McCowan, 2015; Konijnenberg & Melinder, 2011; Nygaard, Moe, Slinning, & Walhovd, 2015). Researchers have highlighted the cumulative negative influence of significant covariates of prenatal opioid exposure such as low SES, poor home environment, and low maternal IQ (Baldacchino, Arbuckle, Petrie, McCowan, 2015). Meta-analysis (Hatzis, Dawe, Harnett, & Barlow, 2017) has confirmed that whilst maternal SM in pregnancy is associated with suboptimal outcomes for the fetus, postnatal environment quality is implicated in reducing or exacerbating the risks posed. In this context one of the most salient aspects is the quality of the infant's relationship with their primary caregiver (Hatzis, Dawe, Harnett & Barlow, 2017).

### *Maternal-infant relationship quality*

MIR can be understood as the combination and interaction of the cognitive, emotional and behavioural aspects of two key systems: the mother's caregiving system, and the infant's attachment system.

The caregiving system is a behavioural system that promotes protection and nurture of the fetus/infant. When a mother's caregiving system is activated, she is motivated to provide care, comfort, and protection for her child (George & Solomon, 1996). Likewise, the infant attachment (behavioural) system gives rise to mental representations, feelings, and actions. The purpose of the attachment system is to elicit care from others (primarily from known caregivers; Walsh, 2010), to maximise safety, security, and healthy development (Walsh, 2010).

It is hypothesised that a mother's caregiving system develops from her own early attachment (care-seeking) experiences (George & Solomon, 1996). Her caregiving system includes a set of cognitive representations (of herself, her infant, and their relationship), that influence her perception of, and interaction with, her child (George & Solomon, 1996). The attachment and caregiving systems therefore represent distinct reciprocal systems, interacting and influencing each other across generations (George & Solomon, 1996).

MIR quality is a significant predictor of infants' physical, psychological, and social developmental outcomes across their lives (Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016; Moreira, Gouveia, Carona, Silva & Canavarro, 2015; Siddiqui & Hägglöf, 2000), and there are several effective interventions designed to promote positive MIR (Barlow et al., 2019; Gardner & Leijten, 2017; MacBeth et al., 2015). However, a point of even earlier intervention is the maternal-fetal relationship (MFR). The MFR refers to the cognitive, affective, and behavioural manifestations of the maternal caregiving system in the perinatal period (Walsh, Hepper, Bagge, Wadephul, & Jomeen (2013).



### *Maternal-fetal relationship quality*

The existence and quality of the MFR is evidenced in the behaviours, attitudes, thoughts, and feelings that show the mother's degree of care for, and commitment to, the fetus (Van den Bergh & Simons, 2009). As with the MIR, the MFR emerges as a product of the mother's caregiving system (George & Solomon, 1996). Activation of the caregiving system in the prenatal period is an innate mammalian characteristic, shaped by evolution to promote a positive intra-uterine environment and reduce threat to the fetus (Sandbrook & Adamson-Macedo, 2004). Alongside significant relational ramifications, MFR quality is also predictive of positive maternal health practices during pregnancy (e.g., good nutrition, exercise, accessing prenatal care, and relaxation), with a recent meta-analysis identifying that MFR quality is a large-effect size predictor of positive maternal health practices during pregnancy (Cannella, Yarcheski, & Mahon, 2018), and of MIR quality (Siddiqui & Hägglöf, 2000).

Understanding the factors related to MFR quality allows formulation of health interventions, and a number of predictors and covariates of MFR quality have been identified. A large meta-analysis examining potential predictors of MFR quality (Yarcheski, Mahon, Yarcheski, Hanks & Cannella, 2009) found that mother's social support, gestational age, and use of ultrasound screening in pregnancy were all related to better MFR quality. Alhusen et al. (2012) reported that, in a sample of predominantly ethnic minority low-income women, social support and depressive symptoms accounted for 65% of the variance of MFR quality. Factors related to positive MFR quality are related to higher SES, e.g., use of ultrasound techniques during prenatal health care, stability within family relationships, and adequate social support (Maas et al., 2014). Factors related to negative MFR quality include depression, anxiety, and SM (Maas et al., 2014). These findings suggest that psychological wellbeing and social supports are important for the development of positive MFR quality.

SM women are at greater risk of having poor social support or stressful relationships (Latuskie et al., 2018) and experiencing psychological distress (Conway, Compton, Stinson, & Grant, 2006), particularly post-traumatic stress (Reynolds et al., 2005), and abuse across the lifespan (Yoon, Kobulsky, Yoon, & Kim, 2017). Abuse and trauma, particularly in childhood, are associated with insecure and disorganised attachment styles (Murphy et al., 2014). As these psychosocial stressors are known predictors/correlates of impaired MFR/MIR quality (Alhusen et al., 2012; Maas et al.,

2014; Yarcheski, Mahon, Yarcheski, Hanks and Cannella (2009), it is possible that SM women are at particular risk of developing poor MFR/MIR quality, as a consequence of the structure, function, and activation of their attachment and caregiving systems as informed by challenging interpersonal and environmental experiences (George & Solomon, 2008; Murphy et al., 2014; White & Widon, 2008; Yoon, Kobulsky, Yoon, & Kim, 2017).

### **Rationale & research questions**

As yet no systematic review has been conducted to synthesise the existing literature regarding MFR QUALITY in women with SM in the perinatal period. Therefore, this review aimed to address the following research questions:

- 1) What is the current evidence for impairments in MFR/MIR quality in the context of perinatal SM?
- 2) If there is an association between maternal SM in the perinatal period and MFR/MIR quality, can important covariates of this association be identified?
- 3) If there is an association between maternal SM in the perinatal period and MFR/MIR quality, what are the implications for infant health and wellbeing outcomes?
- 4) What are the methodological sources of bias in the literature?

## **Method**

### *Inclusion criteria*

- 1) Perinatal period: studies reporting data on women in the perinatal period – defined as during pregnancy and up to one-year post-partum;
- 2) Substance misuse: studies reporting data on women in the perinatal period who were i) using illicit substances, and/or misusing licit substances such as alcohol, tobacco, and/or misusing prescription medication; or ii) who were in treatment for SM. Misuse of licit substances was defined as use with greater frequency and/or in greater quantities than recommended by health professionals;
- 3) Maternal-fetal/infant relationship quality: studies provided a clear definition of MFR/MIR quality, including operationalisation or description of associated behaviours (e.g., specific aspects of caregiving);
- 4) Studies written in English;
- 5) Studies used an experimental or observational design.

### *Search & data extraction*

A systematic review was performed using PRISMA Criteria (Moher, Liberati, & Altman, 2009) in July 2018. Literature searches were conducted in four bibliographic databases: EMBASE, Medline, and PsychINFO, and ProQuest Dissertations and Theses Global. Google Scholar was employed to search for peer-reviewed, in-press research available online but not database indexed, and other 'grey literature' (e.g., unpublished/unregistered theses). Reference sections of included papers were searched to identify unpublished or unindexed literature. Three search terms were identified: 'substance misuse', 'parental relationship', and 'relationship quality'. Table 1 lists keywords for searches. All keywords were combined with "OR", and the three main search terms were combined with "AND".

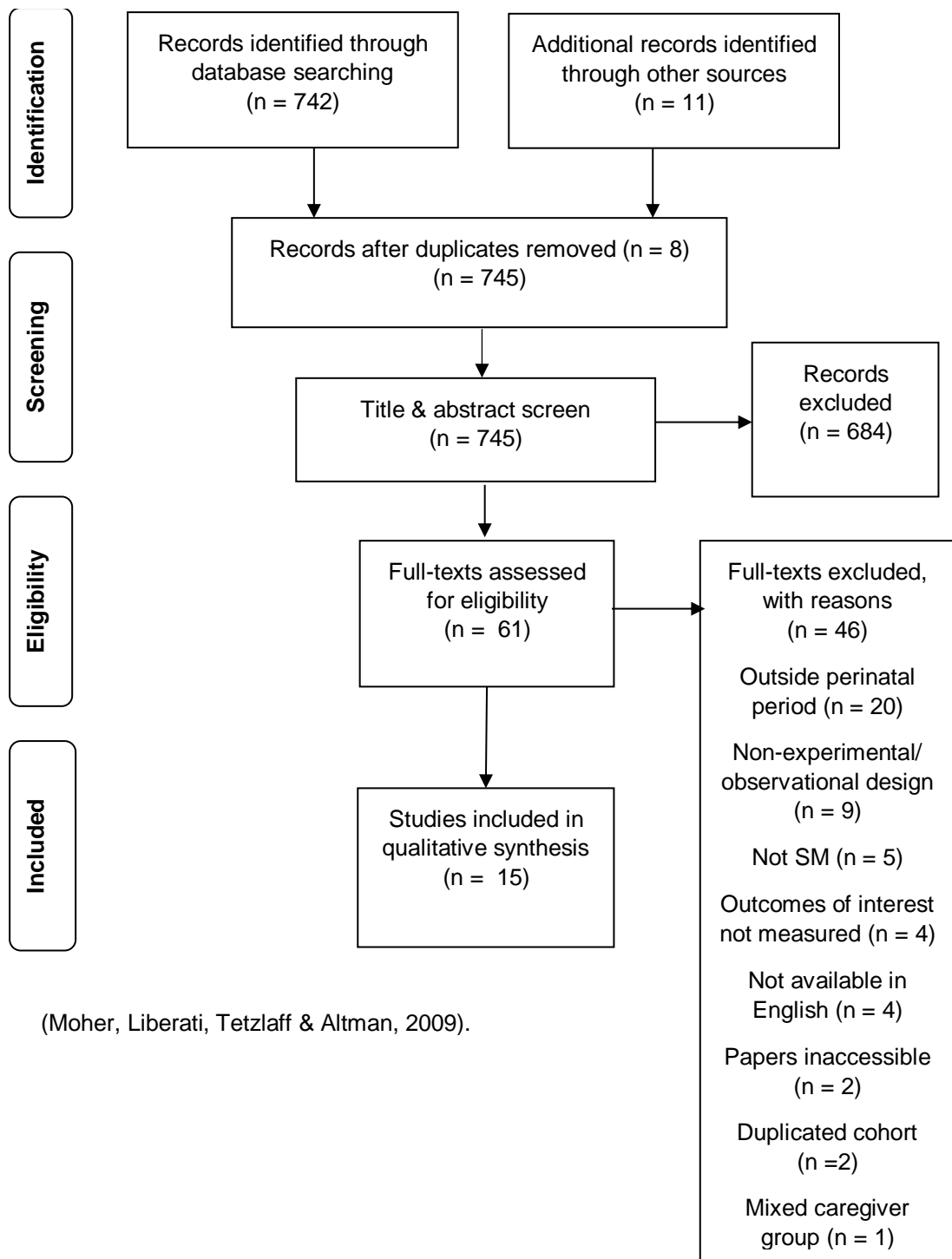
**Table 1: Search term categories and keywords**

<b>Term 1: substance misuse</b>	<b>Term 2: parental relationship</b>	<b>Term 3: relationship quality</b>
Substance misuse/ use/abuse	Mother/parent – child	Relationship
Drug misuse/use/abuse	Mother/parent – infant	Attachment
Alcohol misuse/ use/abuse	Mother – f?tus	Bond
Addict\$	Maternal – f?etal	Representation
	Caregiver	

The initial search identified 742 records for review. Eleven records were identified for review using ProQuest Dissertations and Theses Global, Google Scholar, and searching references of related papers. Once duplicates (eight studies) were removed, 745 records were abstract screened by the first author, excluding 684 records that did not meet inclusion criteria. The remaining 61 records were subjected to full text review. After full text screening (see Figure 1, p.20 for exclusions), 15 studies were included in the final review sample.

Findings are reported regarding the association between SM and MFR/MIR. Additional information regarding data linking maternal psychosocial factors to maternal SM and/or MFR/MIR quality is also described. See Table 2, pp.21-38, for a summary of study characteristics and findings.

**Figure 1: PRISMA diagram of systematic search process**



(Moher, Liberati, Tetzlaff & Altman, 2009).

**Table 2: Study characteristics & main findings**

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Belt (2012)</b> Longitudinal intervention, within & between subjects.	<p><b>SM</b> N = 51; Poly-substance; 25.53yrs (4.16); 18% single parent; 78% nulliparous; 59% basic education, 4% university; 39% unemployed.</p> <p><b>Comparison</b> N = 50; 29.24yrs (5.02); 4% single parent; 46% nulliparous; 12% basic education, 22% university; 6% unemployed.</p>	<p><b>SM</b> 28wks – 1mth postpartum at T1.</p> <p><b>Comparison</b> 28wks – 1mth postpartum at T1.</p>	<p><b>MIR:</b> EAS<sup>1</sup> . <b>SM:</b> AUDIT<sup>2</sup>.</p> <p><b>Infant:</b> EAS<sup>1</sup>.</p> <p><b>Other:</b> EPDS<sup>3</sup>; CES- DS<sup>4</sup>.</p> <p><b>Analyses:</b> One-way MANCOVAs; Tukey's b; chi-square test.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> Post-intervention: SM group poorer EAS outcomes vs. comparison: sensitivity, <math>F = 7.28</math>, <math>p &lt; .05</math>, <math>d = .54^*</math>; structuring, <math>F = 4.76</math>, <math>p &lt; .05</math>, <math>d = .44</math>; non-intrusiveness, <math>F = 6.93</math>, <math>p &lt; .05</math>, <math>d = .53</math>; non-hostility, <math>F = 3.67</math>, <math>p &lt; .05</math>, <math>d = .39</math>. 12mths follow-up: SM group poorer outcomes vs. comparison: sensitivity, <math>F = 8.54</math>, <math>p &lt; .05</math>, structuring <math>F = 5.67</math>, <math>p &lt; .05</math>, <math>d = .59</math>.</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Education: sig. covariate of non-hostility (<math>p &lt; .05</math>); detailed statistics not reported. SM group lower education vs. comparison: <math>X^2 = 40.03</math> (<math>r = .63^*</math>). SM group less likely to be married/in a committed relationship vs. comparison <math>X^2 = 24.35</math> (<math>r = .49</math>). Economic hardship: sig. covariate for depression (<math>F_{Wilks's} (2, 70) = 10.74</math>, <math>p &lt; .0001</math>, <math>\eta^2 = .23</math>).</p> <p><b>INFANT OUTCOMES</b> --</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Blackwell (1998)</b> Longitudinal between subjects. <i>Blackwell (1998) continued.</i>	<b>SM Group 1</b> N = 21; Cocaine; 26.2yrs (5.14); 97% African American; Social support 39.6 (6.7); 11.2yrs (1.9) in education; 100% 'lower income'. <i>4mths postpartum Group 1 relapsed into SM.</i>  <b>SM Group 2</b> N = 13; Cocaine; 28.2yrs (4.8); 97% African American; Social support 46.0 (10.5); 11.5yrs (1.4) in education; 100% 'lower income'. <i>4mths postpartum Group 2 remained abstinent.</i>	<b>Group 1</b> 38 (3.70) wks; 2850.80g (706.00); 21.10cm (1.70) head circ.; 1 min Apgar 7.10 (2.40) & 5 min Apgar 8.50 (1.40).  <b>Group 2</b> 39.6wks (0.5); 3292.20g (566.00); 33.40cm (1.20) head circ.; 1 min Apgar 7.70 (2.50) & 5 min Apgar 8.90 (0.78).	<b>MIR:</b> NCAFS <sup>5</sup> .  <b>SM:</b> case note review.  <b>Infant:</b> BSID- II <sup>6</sup> .  <b>Other:</b> CHMSSS <sup>7</sup> , BSI <sup>8</sup> .  <b>Analyses:</b> One way ANOVAs; multiple regression.	<b>SM &amp; MFR/MIR QUALITY</b> SM NCAFS score low compared vs. scale norms at 4mths: 30.30 (6.80) & 6mths: 25.45 (3.67). SM vs. comparison NCAFS score at 6mths: 25.45 (3.67) vs. 31.00 (5.60); $F = 7.37$ , $p = .01$ .  <b>DEMOGRAPHICS/COVARIATES</b> Social support: 13% of variance in relapse status.  <b>INFANT OUTCOMES</b> BSID-II at 4mths sig. lower for SM Group 1 vs. SM Group 2: 90.85 (24.60) vs. 105.92 (14.30) ( $p = < .01$ ); no sig. diff. at 6mths. SM Group 1 more likely to have NCAFS 'at risk' score at 6mths postpartum vs. SM Group 2 (100% vs. 70%; $F = 7.37$ , $p = .01$ $d = .99^*$ ); no sig. diff. at 4 months postpartum (76% vs 66%). NCAFS & BSID-II (MDI) correlated at 4mths ( $r = .32$ , $p < .001$ ) & 6mths ( $r = .51$ , $p < .001$ ).

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Goldman-Fraser (1997)</b> Longitudinal between subjects.	<p><b>SM</b> N = 21; Polydrug &amp; alcohol; 27.8yrs (5.07); 56% African American; 90% unmarried, 48% 1yr+ relationship; 32% primiparous; 81% high school graduates; 10% panic disorder, 5% generalised anxiety, 10% personality disorder, 5% post-traumatic stress.</p> <p><b>Comparison</b> N = 27; 26.9yrs (8.63); 57% African American; 48% unmarried, 82% 1yr+relationship; 38% primiparous; 85% high school graduates; Psychiatric status not reported.</p>	<p><b>SM</b> 39wks (2.8); 3130g (822); 33.7cm (2.49) head circ.; 50.3cm (4.00) length; 5-min Apgar 2.9 (11.9).</p> <p><b>Comparison</b> 39wks (1.78); 3390g (553); 33.5cm (2.02) head circ.; 51.0cm (5.29) length; 5-min Apgar 8.9 (.34).</p>	<p><b>MFR/MIR:</b> PIBS<sup>9</sup>; ORIB<sup>10</sup>; EAS<sup>1</sup>.</p> <p><b>SM:</b> SM diagnosis.</p> <p><b>Infant:</b> ORIB<sup>10</sup>; BSID-II (MDI &amp; PDI)<sup>6</sup>.</p> <p><b>Other:</b> FSS<sup>11</sup>; MSEQ<sup>12</sup>; PCS<sup>13</sup>; KIDI<sup>14</sup>; LSC<sup>15</sup>; SCL- 90-R<sup>16</sup>.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> Prenatal: fewer SM women believed SM use in pregnancy harmful to child development (<math>X^2 = 6.2</math>, <math>p &lt; .01</math>, <math>r = .36^*</math>). No sig. diff. in SM vs. comparisons': <i>prenatal self-efficacy</i> 3.3 (.37) vs. 3.4 (.24); <i>expectations of parenting competence</i> 2.8 (.34) vs. 2.9 (.31); or <i>expectations of infant behaviour</i> 61 (10.73) vs. 62 (12.00). Maternal sensitivity (EAS) in SM vs. comparisons: 6.00 (.84) vs. 6.60 (.90); <math>F = 5.5</math> (<math>p &lt; .05</math>, <math>d = .70</math>). NB: not clinically sig. Maternal hostility (EAS) in SM vs. comparisons: 1.4 (.55) vs. 1.2, (.37) (<math>p &gt; .05</math>). Child responsiveness in SM vs. comparisons: 4.4 (1.02) vs. 4.8 (1.01) (<math>p &gt; .05</math>). Agreement in mother/observer rating of infant behaviour (SM = 57%, comparison = 69%). Severity of SM: neg. correlated with maternal sensitivity (<math>r = -.34</math>); pos. correlated maternal depression &amp; maternal hostility (<math>r = 0.32</math>) at 3mth follow-up. NB: not clinically sig.</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Married: SM (10%) vs. comparison (52%); <math>X^2 = 9.5</math> (<math>p = .01</math>, <math>r = .45^*</math>). SM vs. comparisons (prenatal &amp; 3 mths postpartum): <i>depression</i> (<math>F = 8.7</math>, <math>p &lt; .001</math>, <math>d = .88^*</math>) vs. (<math>F = 12.2</math>, <math>p &lt; .05</math>, <math>d = 1.04^*</math>); <i>stress</i> (<math>F = 24.1</math>, <math>p &lt; .001</math>, <math>d = 1.50^*</math>) vs. (<math>F = 23.4</math>, <math>p &lt; .001</math>, <math>d = 1.44^*</math>); <i>emotional abuse</i> (<math>F = 12.1</math>, <math>p &lt; .001</math>, <math>d = 1.03^*</math>) vs. (<math>F = 8.7</math>, <math>p &lt; .001</math>, <math>d = .88^*</math>); <i>physical abuse</i> (<math>F = 15.7</math>, <math>p &lt; .001</math>, <math>d = 1.18^*</math>) vs. (<math>F = 14.8</math>, <math>p &lt; .001</math>, <math>d = 1.14^*</math>); <i>sexual abuse</i> (<math>F = 6.4</math>, <math>p &lt; .05</math>, <math>d = .75^*</math>) vs. (<math>F = 7.3</math>, <math>p &lt; .05</math>, <math>d = .80^*</math>); <i>poorer social support</i> (<math>F = 12.9</math>, <math>p &lt; .001</math>, <math>d = 1.07^*</math>) vs. (<math>F = 7.1</math>, <math>p &lt; .05</math>, <math>d = .79^*</math>).</p>



Author (year); design.	Maternal characteristics <i>N</i> ; <i>SM</i> ; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation)</i> ; birthweight; head circumference; length; 1 min Apgar; 5 min Apgar <b>M, (SD)</b>	Outcome measures; analyses	Key findings
Goldman- Fraser (1997) <i>continued.</i>			<b>Analyses:</b> Pearson correlations; two-way ANOVAs; linear regression.	<p>Prenatal knowledge of infant dev. correlation with: <i>maternal abuse</i> (<math>r = -.30</math>), <i>depression</i> (<math>r = .38</math>), &amp; <i>stress</i> (<math>r = -.41</math>).</p> <p>Postpartum knowledge of infant dev. correlation with: <i>maternal stress</i> (<math>r = -.29</math>), <i>maternal self-efficacy</i> (<math>r = -.41</math>) &amp; <i>perception of infant behaviour</i> (<math>r = -.31</math>).</p> <p>Maternal self-efficacy &amp; perception of infant behaviour (<math>r = .44</math>). Perception of infant behaviour: poorer in SM vs. comparisons (<math>F = 4.36</math>, <math>p &lt; .05</math>, <math>d = .62^*</math>).</p> <p>Degree of SM in pregnancy neg. correlated with: <i>prenatal knowledge of infant dev.</i> (<math>r = -.36</math>, <math>p &lt; .01</math>); <i>perception of infant behaviour</i> (<math>r = -.31</math>, <math>p &lt; .05</math>); <i>maternal experience of abuse at 3mths postpartum</i> (<math>r = -.34</math>, <math>p &lt; .05</math>); <i>stress at 3 mths postpartum</i> (<math>r = -.35</math>, <math>p &lt; .01</math>).</p> <p><b>INFANT OUTCOMES</b></p> <p>Postpartum infant health correlated with pre- and post-natal: <i>maternal perception of infant behaviour</i> (<math>r = -.32</math>, <math>p &lt; .05</math>; <math>r = -.33</math>, <math>p &lt; .05</math>), <i>social support</i> (<math>r = -.34</math>, <math>p &lt; .05</math>; <math>r = -.28</math>, <math>p &lt; .05</math>), <i>emotional, physical and sexual abuse</i> (<math>r = .40</math>, <math>p &lt; .01</math>; <math>r = .44</math>, <math>p &lt; .01</math>), <i>depression</i> (<math>r = .32</math>, <math>p &lt; .05</math>; <math>r = .30</math>, <math>p &lt; .05</math>), and <i>prenatal stress</i> (<math>r = .39</math>, <math>p &lt; .01</math>).</p> <p>Cognitive development: SM poorer vs. comparisons (<math>F = 9.0</math>, <math>p &lt; .005</math>, <math>d = .89^*</math>).</p> <p>SM more 'difficult' than comparisons (<math>F = 7.1</math>, <math>p = .01</math>, <math>d = .79^*</math>). Infant 'difficultness' correlated with: <i>maternal prenatal stress</i> (<math>r = .36</math>) &amp; <i>postpartum depression</i> (<math>r = .33</math>). Infant 'difficultness' correlated with: <i>maternal sensitivity</i> (<math>r = -.29</math>) &amp; <i>maternal hostility</i> (<math>r = .44</math>).</p> <p>Cognitive development correlated with: <i>mothers' experience of abuse</i> (prenatal: <math>r = -.35</math>; postnatal: <math>r = -.38</math>); <i>maternal prenatal stress</i> (<math>r = -.31</math>); <i>maternal knowledge of infant development</i> (<math>r = -.31</math>).</p> <p>Degree of prenatal SM correlated with infant health problems (<math>r = .70</math>).</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Hogan (2002)</b> Longitudinal between subjects.	<p><b>SM treatment group</b> N = 78; 29yrs; 87% African-American; 91% single; 10% partial college education.</p> <p><b>SM refuser group</b> N = 21; 27yrs; 86% African-American; 86% single; 14% partial college education.</p> <p><b>Comparison</b> N = 49; 24yrs; 69% African-American; 82% single; 33% partial college education.</p>	<p><b>SM treatment group</b> 2973g (605); 33.1cm (1.7) head circ.; 49.5cm (3.5) length; 1 min Apgar 7.8 (1.7); 5 min Apgar 8.8 (0.6)</p> <p><b>SM refuser group</b> 3015g (SD = 576); 33.3cm (SD = 1.9) head circ.; 49.2 cm (SD = 2.8) length; 1 min (M = 8.1, SD = 0.7) &amp; 5 min Apgar (M = 8.9, SD = 0.3).</p> <p><b>Comparison</b> 3131g (SD = 561); 33.8 cm (SD = 1.5) head circ.; 49.6 cm (SD = 2.5) length; 1 min (M = 7.9, SD = 1.7) &amp; 5 min Apgar (M = 8.8, SD = 0.6).</p>	<p><b>MIR:</b> NCATS<sup>17</sup>.</p> <p><b>Other:</b> CAP<sup>18</sup>.</p> <p><b>Analyses:</b> Mixed model ANOVA; cross-lagged correlations; stepwise multiple regression.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> Between groups MFR: <i>SM treatment</i> = 55.86; <i>Refuser SM</i> = 54.72; <i>comparison</i> = 54.81; <i>F</i> = 1.25, <i>p</i> = .29)</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Ethnic minority status predicted poorer MIR at 2mths (<math>\beta</math> = -.20, <i>p</i> &lt; .05). Greater education predicted better MIR at 12mths (<math>\beta</math> = .26, <i>p</i> &lt; .01). Comparison group sig. younger than SM treatment or refuser groups (<i>F</i> = 19.7, <i>p</i> &lt; .001). Comparison group sig. higher rate of education (<math>X^2</math> = 19.99, <i>p</i> = .05).</p> <p><b>INFANT OUTCOMES</b> Infant health outcomes did not predict of MIR/infant behaviour.</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Huebner (2002)</b> Between/within subjection longitudinal intervention. .	<p><b>SM</b> N = 57; 30.71yrs (5.48); 51.8% White, 23.2% Black; 91% single, 69% co- parent; 24% primiparous; 11.33yrs (1.90) education; 92.9% receiving benefits.</p> <p><b>Comparison</b> N = 85; 24.94yrs (7.78); 17.1% White, 32.9% Black; 86.6% single, 88.9% co- parent; 68% primiparous; 11.46yrs (2.30) education; 57.5% receiving benefits.</p>	<p><b>SM</b> 8.61mths (8.27).</p> <p><b>Comparison</b> 6.80mths (7.61).</p>	<p><b>MIR:</b> HOME<sup>19</sup>; NCATS<sup>17</sup>.</p> <p><b>Other:</b> PSI<sup>20</sup>.</p> <p><b>Analyses:</b> T- tests; linear regression.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> SM vs. comparison: <i>higher</i> NCATS 51.46 (6.56) vs. 45.90 (8.40), <math>p = &lt;.001</math>.</p> <p><b>DEMOGRAPHICS/COVARIATES</b> SM vs. comparison: <i>higher parenting stress</i> 65.31 (16.94) vs. 85.72 (28.67), <math>p = &lt;.001</math>; <i>poorer home environment</i> 32.38 (4.58) vs. 25.50 (6.42), <math>p = &lt;.001</math>.</p> <p><b>INFANT OUTCOMES</b> --</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Johnson (1990)</b> Longitudinal within subjects.	<b>SM</b> N=75; 'Low' SES & receiving benefits.	--	<p><b>MIR:</b> bespoke scale.</p> <p><b>SM:</b> bespoke tool.</p> <p><b>Infant:</b> CQ<sup>21</sup>.</p> <p><b>Other:</b> bespoke observer ratings.</p> <p><b>Analyses:</b> within- subjects correlations.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> No correlation between intensity of SM &amp; maternal responsiveness (no statistics reported). No correlation between mothers' and observers' rating of infant: <i>approach, adaptability, mood, distractibility</i> (no statistics reported). Correlation between mothers' &amp; observers' rating of infant activity: (<math>r = .32, p = &lt; .05</math>) and persistence (<math>r = .28, p = &lt; .05</math>). Maternal SM (type &amp; frequency) correlated with maternal reports of 'easy baby' characteristics (<i>approach</i> <math>r = .27</math>; <i>adaptability</i> <math>r = .24</math>; <i>mood</i> <math>r = .23</math>).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Maternal rating of infant temperament correlated with maternal responsiveness (<math>r = .27, p &lt; .05</math>). Mothers with 'more constructive interactions' more likely to perceive their infant positive responses (<math>r = .27, p &lt; .05</math>).</p> <p><b>INFANT OUTCOMES</b> --</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Kelly (2002)</b> Longitudinal between subjects.	<p><b>SM on-going group (ONGO)</b> N = 25; 33yrs (5.32); 88% African-American; 78% single; 11.4yrs (1.9) education; 33.3% 'lower class'.</p> <p><b>SM abstinent group (ABST)</b> N = 41; 31yrs (6.27); 76% African-American; 78% single; 11.8yrs (1.4) education; 17.1% 'lower class'.</p> <p><b>Comparison</b> N = 132; 27yrs (6.03); 85% African-American; 78% single; 12.1yrs (1.9) education; 21% 'lower class'.</p>	<p><b>SM ONGO</b> 38-42wks (52%); 2527g (879).</p> <p><b>SM ABST</b> 38-42 wks (56%); 2673g (70).</p> <p><b>Comparison</b> 49.2% delivered at 38- 42wks; 2547g (807).</p>	<p><b>MIR:</b> HOME<sup>18</sup>.</p> <p><b>SM:</b> ASI<sup>22</sup>.</p> <p><b>Infant:</b> Meconium screen.</p> <p><b>Other:</b> CISU<sup>23</sup>, ACYF<sup>24</sup>, SES<sup>25</sup>, SRC<sup>26</sup>.</p> <p><b>Analysis:</b> Chi-square; ANOVA.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> No correlation between SM status &amp; quality of home environment: <math>F = 1.62</math> (<math>p = .20</math>).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> HOME Environment correlated with SES risks (<math>r = -.34</math>, <math>p = &lt;.005</math>). SM likely to have education level less than high school; <math>X^2 = 6.64</math>, <math>p = .01</math>, <math>d = .67^*</math>. SM dyads sig. more likely to have low maternal education and low income (<math>X^2 = 12.35</math>, <math>p = .002</math>, <math>d = .96^*</math>). Degree of contact between father and child sig. related to the number of SES risks experienced by the mother/child dyad (<math>X^2 = 7.01</math>, <math>p = .01</math>, <math>d = .69^*</math>). Home environment &amp; SES (<math>r = -.34</math>, <math>p &lt;.005</math>).</p> <p><b>INFANT OUTCOMES</b> --</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Magee (2014)</b> Longitudinal within subjects.	<b>SM</b> N = 58; Tobacco only; 25yrs (5.0); 22% Black, 19% Hispanic, 53% White; 35% not in committed relationship; 83% planned pregnancy; 77% unemployed;; Mean income <\$20,000.	<b>SM</b> 39wks (2.0); 3097g (471); 6% small for gestational age.	<b>MFR/MIR:</b> MFAS-13 <sup>27</sup>  <b>SM:</b> TLFB <sup>28</sup> ; saliva test for cotinine.  <b>Infant:</b> Fenton Growth Chart review.  <b>Analysis:</b> Spearman correlations; ANCOVA.	<b>SM &amp; MFR/MIR</b> Poorer MFR correlated with greater smoking at 30wks gestation ( $r = -.28$ , $p = .05$ ), & at 1 day postpartum ( $r = -.32$ , $p = .02$ ).  <b>DEMOGRAPHICS/COVARIATES</b> --  <b>INFANT OUTCOMES</b> Low MFR group sig. lower birth weight percentile vs. high MFR group: 30 (23), vs. 42 (20) ( $p < .05$ ).

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>McCullough (1999)</b> Cross- sectional between subjects.	<p><b>SM</b> N = 35, Polydrug, 28.4ys (5.6); 86% Black, 11% White, 3% mixed heritage.</p> <p><b>Comparison</b> 26.6yrs (5.8); 88% Black, 11% White, 1% mixed heritage. <b>Combined sample:</b> 92% single; 93% receiving Medicaid.</p>	<p><b>SM</b> 38wks (2.1); 2757.5g (519.3).</p> <p><b>Comparison</b> 38.6wks (1.6); 3288.8g (511.0).</p>	<p><b>MFR/MIR:</b> PCIS<sup>29</sup>, MBQ<sup>30</sup>, AQ<sup>31</sup>.</p> <p><b>SM:</b> Toxicology screens, ASI<sup>22</sup>.</p> <p><b>Analysis:</b> Independent t tests; Pearson correlations; regression.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> No sig. diff. in maternal sensitivity for SM vs. comparisons: .32 (.46) vs. .37 (.44) (<math>p &lt; .05</math>; <math>d = .11</math>). No sig. diff. in maternal involvement for SM vs. comparisons: 2.6 (.77) vs. 2.5 (.73) (<math>p &lt; .05</math>, <math>d = -.14</math>).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Caregiver involvement most sig. predictor of AQ for SM (<math>r = .55</math>, <math>r = .57</math>, <math>r = .53</math> in 1st, 2nd and 3rd trimesters). Maternal involvement &amp; maternal sensitivity sig. predicted AQ security regardless of SM (<math>\beta = .40</math>, <math>R^2 = .30</math>).</p> <p><b>INFANT OUTCOMES</b> Alcohol exposure in the 1st (<math>\beta = .35</math>, <math>R^2 = .30</math>, <math>p &lt; .05</math>) &amp; 2nd (<math>\beta = .29</math>, <math>R^2 = .32</math>, <math>p &lt; .05</math>) trimester sig. predicted greater attachment security over time, &amp; accounted for greater variance in attachment security than cocaine use, maternal involvement, or maternal sensitivity.</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Mikhail (1995)</b> Cross- sectional between subjects. .	<b>SM</b> N = 17; Methadone maintenance; 26yrs (5.2); 47.1% Hispanic, 35.3% African-American, 17.6% White; 53% unmarried; 35.3% nulliparous.  <b>Comparison</b> N = 50; 27yrs (4.8); 48% Hispanic, 36% African-American, 16% White; 53% unmarried; 34% nulliparous.	<b>SM</b> 34wks (2.6).  <b>Comparison</b> 33 wks (2.2).	<b>MFR:</b> MFAS <sup>27</sup> .  <b>Analysis:</b> Chi-square tests; t-tests.	<b>SM &amp; MFR/MIR QUALITY</b> SM sig. poorer MFR vs. comparisons: 2.46 (.67) vs. 2.92 (.73), $p = <.02$ , $d = -.10$ .  <b>DEMOGRAPHICS/COVARIATES</b> --  <b>INFANT OUTCOMES</b> --



Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Nash (2013)</b> Cross- sectional between subjects.	<p><b>SM</b> N = 9; 32.6yrs (6.7); 88.9%; 'low education' 100% 'low income'; 55.6%. hx. depression.</p> <p><b>Comparison</b> N = 9; 33.2yrs (4.3); 11% 'low education'; 0% 'low income'; 44.4% 55.6%..</p>	<p><b>SM</b> 10.7mths (3.1) at assessment.</p> <p><b>Comparison</b> 10.7mths (2.9) at assessment.</p>	<p><b>MFR/MIR:</b> ICEP<sup>33</sup>, CIB<sup>34</sup>.</p> <p><b>Infant:</b> IBQ- R<sup>35</sup>, ITSC<sup>36</sup></p> <p><b>Other:</b> CES- D<sup>4</sup>; DLC<sup>37</sup>.</p> <p><b>Analysis:</b> Mann- Whitney U (group comparison of maternal sensitivity)</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> Incidence of dyadic mismatching during play: SM = 41% to 97%; comparison = 29% to 100%. Slightly more negative mother-infant interactions in SM (0.7%) vs. comparison (0%) groups during play. SM &amp; comparisons had similar degree of positive engagement behaviours (95.8% vs. 98.1%).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Mothers of infants prenatally exposed to alcohol reported to have: lower household income, lower level of education, high level of tobacco and drug use during pregnancy (none reported in controls), higher levels of life stressors and slightly higher levels of past diagnosis and/or treatment for depression than the control group – detailed statistics no reported for these findings.</p> <p><b>INFANT OUTCOMES</b> Mean scores on the ITSC-36 were higher for infants prenatally exposed to alcohol than controls (as rated by mothers) – statistical significance unclear. Of infants in the prenatal alcohol exposure group with mismatched interactions &gt;50%, 5/7 infants had mean fear scores above the 2.8 cut off. 2/5 control infants with mismatched interactions &gt;50% had mean fear scores above 2.8. None of the infants in either group with mismatched interactions &lt;50% had a mean fear score above 2.8.</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>O'Connor (1992)</b>  Cross- sectional within subjects.	<b>SM</b> N = 44; Alcohol; 30+ years; 98% married; 100% primiparous; 70% under- or –post- graduates; 100% ‘middle class’.	<b>SM</b> 100% full-term.	<b>MIR:</b> MCRS <sup>38</sup> .  <b>SM:</b> bespoke questionnaire .  <b>Infant:</b> Examination by paediatrician; health hx . <b>Analysis:</b> EQS regression modelling; chi-squared test.	<b>SM &amp; MFR/MIR QUALITY</b> Greater alcohol in pregnancy sig. related to infant negative affect during mother-infant interaction ( $r = .36, p = .05$ ). Infant negative affect negatively correlated with maternal elaboration ( $r = -.32, p < .05$ ) and maternal stimulation ( $r = -.54, p < .05$ ). Maternal elaboration ( $r = .35, p < .05$ ) and maternal stimulation ( $r = .40, p < .05$ ) related to greater security of child attachment style.  <b>DEMOGRAPHICS/COVARIATES</b> --  <b>INFANT OUTCOMES</b> Attachment style: secure (50%), insecure-avoidant (14%), insecure-ambivalent (5%), disorganised (32%).

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Pajulo (2012)</b>  Longitudinal within subjects.	<b>SM</b> N = 34; Polysubstance; 25.1yrs (5.8); 44% single-parent families; 65% unplanned pregnancy; 68% nulliparous; 44% long-term unemployment.	<b>SM</b> 39.4 wks (1.7); 3329g (456); 31% withdrawal symptoms; 3% fetal alcohol syndrome.	<b>MFR/MIR:</b> PI <sup>39</sup> ; PDI-R <sup>40</sup> ; CI <sup>41</sup> .  <b>SM:</b> bespoke questionnaire .  <b>Infant:</b> BSID- II <sup>6</sup> . <b>Other:</b> EPDS <sup>3</sup> ; BSI <sup>8</sup> ; TAQ <sup>42</sup> .  <b>Analyses:</b> Spearman correlations; one-way and factorial ANOVA; general linear model; logistic regression; t- test.	<b>SM &amp; MFR/MIR QUALITY</b> Prenatal PI scores ( $M = 2.4$ , $SD = 1.3$ ) indicated weak reflective function. Prenatal PI score correlated with postnatal PDI-R score ( $r = .56$ , $p = .02$ ). SM status not predictive of dyadic mutuality $\beta = .19$ ( $p = .09$ ).  Pre- and postnatal reflective function levels not associated with maternal interaction results, psychiatric symptoms, or child-development scores. Prenatal & postnatal PI not sig. related to maternal interaction quality (no statistics reported).  Mother-infant interactions rated as 'weak': >50% 'high risk' re. sensitivity & 45% 'high risk' re. unresponsiveness.  Women whose children were later fostered, prenatal & postnatal reflective function was (non-sig.) lower than other women's ( $p = .08$ , odds ratio = 2.3, 95% $CI = 0.91$ to 5.9).  <b>DEMOGRAPHICS/COVARIATES</b> Higher maternal education associated with higher maternal postnatal reflective function ( $F = 2.75$ , $p = .06$ , $d = .41^*$ ).  Psychiatric symptoms not sig. correlated with reflective function (statistics not reported).

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<i>Pajulo (2012 continued.)</i>				<p>Greater exposure to physical abuse and secrets within the family in early childhood, respectively, corresponded to less positive change in reflective function during the intervention across all reflective function values, ranging from <math>r = -.66</math> (<math>p = .02</math>) to <math>r = -.56</math> (<math>p = .07</math>).</p> <p>The greater maternal experience of family secrets, physical and emotional abuse, or neglect during her lifetime, the less positive change in reflective function was observed during the intervention, ranging from <math>r = -.77</math> (<math>p = .01</math>) to <math>r = -.53</math> (<math>p = .07</math>).</p> <p><b>INFANT OUTCOMES</b> All infants showed development within normal limits at 4mths on BSID-II (MDI): 97.5 (7); (PDI): 95.3 (8.4).</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
<b>Sarfi (2011)</b> Cross- sectional between subjects.	<p><b>SM</b> N = 36; Opioid maintenance treatment; 32.3yrs; 39% single parent; 10yrs education; 94% unemployed; 30% living in residential setting.</p> <p><b>Comparison</b> N=35; 32.5yrs; 0% single parents; 16yrs education; 0% unemployed; 0% living a residential setting.</p>	<p><b>SM</b> 38.6wks; 3136g.</p> <p><b>Comparison</b> 40.00 wks; 3613g.</p>	<p><b>MIR:</b> bespoke.</p> <p><b>SM:</b> ASI<sup>22</sup>; urine screens.</p> <p><b>Infant:</b> BINS<sup>43</sup>; TSFI<sup>44</sup>; meconium screen.</p> <p><b>Other:</b> Bespoke questionnaire s HSCL-25<sup>45</sup>; EPDS<sup>3</sup>; PSI<sup>20</sup>.</p> <p><b>Analyses:</b> Independent samples t- tests; correlations; regression.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> Dyadic mutuality associated with maternal style (<math>r = .73, p = &lt; .01</math>) &amp; infant style (<math>r = .46, p = &lt; .01</math>). Maternal style strongest predictor of dyadic mutuality at 6mths postpartum (<math>\beta = .57, p = .001</math>). Individual differences thought more influential to MIR quality than mothers' SM. Dyadic mutuality associated with infant birth weight (<math>r = .31, p = &lt; .01</math>), BINS total score (<math>r = .24, p = &lt; .01</math>), TSFI total score (<math>r = .47, p = &lt; .01</math>), &amp; infant style (<math>r = .46, p = &lt; .01</math>).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> Mothers' educational level and group membership were highly correlated (<math>r = .83</math>). No psych. distress symptoms above clinical cut-off, but SM mothers had higher overall psychological distress (<math>F = 26.4, p &lt; .001, d = 1.24^*</math>). Psych. distress was not sig. associated with dyadic mutuality in SM r comparison groups (<math>\beta = -.04, R^2 = .04, p = .09</math>). Mean opioid maintenance treatment 22 mths (1 to 63mths, median 10mths). Not sig. associated with maternal style. No group diff. in parenting stress.</p> <p><b>INFANT OUTCOMES</b> Comparison infants heavier (<math>F = 2.8, p &lt; .001, d = .40^*</math>), but both groups within normal limits. Infant style associated with dyadic mutuality in the substance exposed group (<math>r = .66, p &lt; .05</math>).</p>

Author (year); design.	Maternal characteristics <i>N; SM; age; ethnicity; social support; # pregnancy; education; SES; employment; psychiatric status</i> <b>M, (SD)</b>	Infant characteristics <i>Wks (gestation); birthweight; head circumference; length; 1 min Apgar; 5 min Apgar</i> <b>M, (SD)</b>	Outcome measures; analyses	Key findings
Sarfi (2011) <i>continued</i>				Infant sensory function in normal range, but substance exposed infants scoring lower than comparisons ( $F = 5.4, p < .001, d = .56^*$ ). Similar findings for screening of cognitive development ( $F = 5.7, p < .001, d = .58^*$ ).
<b>Shieh (2006)</b> Cross- sectional between subjects.	<p><b>SM Marijuana</b> N = 19; 23.4yrs (5.9); 79% African American, 21% Hispanic, 0% White; 95% unmarried; 25.9wks (5.4) gestation; 10.8yrs (1.5) education.</p> <p><b>SM Cocaine/heroin</b> N = 17; 29.4yrs (4.9); 53% African American; 14% Hispanic, 33% White; 86% unmarried; 29.4wks (5.3 gestation); 11.6yrs (1.2) education.</p>	--	<p><b>MFR:</b> MFAS<sup>27</sup>.</p> <p><b>SM:</b> SDUQ<sup>46</sup>.</p> <p><b>Other:</b> Medical record review.</p> <p><b>Analyses:</b> T tests; chi- square tests; Fisher's exact test.</p>	<p><b>SM &amp; MFR/MIR QUALITY</b> No sig. diff. between groups' MFR scores: <i>SM marijuana</i> 3.89 (.46); <i>SM cocaine/heroin</i> 3.86 (.49).</p> <p><b>DEMOGRAPHICS/COVARIATES</b> White participants had higher SM vs. non-White participants: 7.29 (2.22) vs. 3.97 (2.92). Polydrug users had higher SM vs. single-drug users: 7.71 (2.56) vs. 3.88 (2.75).</p> <p><b>INFANT OUTCOMES</b> --</p>

**Table 2 notes:** <sup>1</sup>**Emotional Availability Scales** (Biringen, 2008); <sup>2</sup>**Alcohol Use Disorders Identification Test** (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993); <sup>3</sup>**Edinburgh Postnatal Depression Scale** (Cox, Holden & Sagovsky, 1987); <sup>4</sup>**Center for Epidemiological Studies – Depression Screen** (Radloff, 1977); <sup>5</sup>**Nursing Child Assessment Feeding Scale** (Sumner & Spietz, 1994); <sup>6</sup>**Bayley Scales of Infant Development** (Bayley, 1993); <sup>7</sup>**Children’s Hospital Maternal Social Support Scale** (Blackwell, Kirkhart, Schmitt, & Kaiser, 1998); <sup>8</sup>**Brief Symptom Inventory** (Derogatis, 1993); <sup>9</sup>**Perception of Infant Behaviour Scale** (Nover, Shore, Timberlake, & Greenspan, 1984); <sup>10</sup>**Objective Rating of Infant Behaviour Scale** (Goldman-Fraser 1997); <sup>11</sup>**Family Support Scale** (Dunst, Jenkins, & Trivette, 1987); <sup>12</sup>**Maternal Self-Efficacy Questionnaire** (Teti & Gelfand, 1991); <sup>13</sup>**Parenting Competence Scale** (Epstein, 1980); <sup>14</sup>**Knowledge of Infant Development** (MacPhee, 1981); <sup>15</sup>**Life Stressor Checklist** (Wolfe, & Kimerling, 1997); <sup>16</sup>**Symptom Checklist-90-Revised** (Derogatis, 1983); <sup>17</sup>**Nursing Child Assessment Teaching Scale** (Barnard, 1978); <sup>18</sup>**Child Abuse Potential Inventory** (Milner, 1980); <sup>19</sup>**Home Observation Measurement of the Environment – Infant/Toddler Inventory** (Caldwell & Bradley, 1984); <sup>20</sup>**Parenting Stress Index** (Abidin, 1990); <sup>21</sup>**Carey Questionnaire** (Carey, 1970); <sup>22</sup>**Addiction Severity Index** (McLellan et al., 1992); <sup>23</sup>**Caretaker Inventory of Substance Use** (Kelly, 2002); <sup>24</sup>**Administration on Children, Youth, and Families** (Kelly, 2002); <sup>25</sup>**Socio Economic Status Scale** (Kelly, 2002); <sup>26</sup>**Social Risk Composite Index** (LaGasse et al., 1999); <sup>27</sup>**Maternal-Fetal Attachment Scale** (Cranley, 1981); <sup>28</sup>**Time Line Follow Back** (Sobell et al., 1996); <sup>29</sup>**P/CIS** (Farran, Kasari, Comfort, & Jay, 1986); <sup>30</sup>**Maternal Behavior Q-set** (Pederson, et al., 1990); <sup>32</sup>**Attachment Q-set** (Waters & Deane, 1985); <sup>33</sup>**Infant and Caregiver Engagement Phases** (Weinberg & Tronick, 1999); <sup>34</sup>**Coding Interactive Behavior** (Feldman, 1998); <sup>35</sup>**Infant Behavior Questionnaire-Revised** (Gartstein & Rothbart, 2003); <sup>36</sup>**Infant Toddler Symptom Checklist** (DeGangi, Poisson, Sickel & Wiener, 1995); <sup>37</sup>**Difficult Life Circumstances** (Barnard, 1994); <sup>38</sup>**Maternal Child Rating Scale** (Crawley & Spiker, 1983); <sup>39</sup>**Pregnancy Interview** (Slade et al., 2004); <sup>40</sup>**Pregnancy Development Interview – Revised** (PDI-R, Slade et al., 2002); <sup>41</sup>**Care Index of Infants and Toddlers** (Crittenden, 2003); <sup>42</sup>**Traumatic Antecedents Questionnaire** (Van der Kolk, 2003); <sup>43</sup>**Bayley Neurodevelopmental Screener** (Aylward, 1995); <sup>44</sup>**Test of Sensory Functions in Infants** (deGangi & Greenspan, 1993); <sup>45</sup>**Hopkins Symptom checklist** (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974); <sup>46</sup>**Severity of Drug Use Questionnaire** (Shieh & Kravitz, 2006).

*\*Effect size calculated using [www.psychometrica.de/calculator](http://www.psychometrica.de/calculator).*

### *Risk of bias assessment*

Risk of bias within included studies was assessed using an adapted bespoke quality assessment tool (Williams, Plassman, Burke, Holsinger, & Benjamin (2010). Studies were rated using this tool and bespoke guidelines (see Appendix B, pp. 150-153) by the first author (Rater One) and an independent assessor (Rater Two). Using the same methodology as Marsh, Chan, and MacBeth (2018) each study was allocated a qualitative and quantitative rating regarding the degree to which each of the eleven risk of bias criteria were met – Yes (2), Partially (1), No/Can't tell (0), and Not Applicable (no score). The sum of these scores were used to calculate a percentage score. A score of 80-100% was categorised as 'low risk of bias' (n = 1 study); 60-79% was categorised as 'moderate risk of bias' (n = 7 studies); and 59% or less was categorised as 'high risk of bias' (n = 7 studies). See Table 3, pp.40 – 41, for risk of bias ratings for each included study.

Inter-rater reliability was assessed by comparing Rater One and Rater Two's scores on eight randomly selected studies; the kappa coefficient was found to be 0.52, indicating moderate agreement between Raters One and Two. After consensus discussion kappa coefficient increased to 0.84 (high agreement).



**Table 3: Risk of bias ratings**

First author & date	Design	Unbiased selection	Min baseline diff	Sample size calculation	Cohort description	Relationship measure	Substance use measure	Blinded outcome assessment	Adequate follow-up	Missing/drop out data	Analysis for controls confounds	Appropriate analysis	Total Score	Percentage	Risk descriptor*
<b>Belt (2012)</b>	Longitudinal Intervention Between & Within Subjects	0	0	0	2	2	1	2	1	2	2	2	14/22	64%	Mod
<b>Blackwell (1998)</b>	Longitudinal Between Subjects	1	0	0	2	2	0	0	1	1	2	1	10/22	45%	High
<b>Goldman-Fraser (1997)</b>	Longitudinal Between Subjects	1	2	0	2	2	2	1	1	1	2	1	15/22	68%	Mod
<b>Hogan (2002)</b>	Longitudinal Between Subjects	2	1	0	2	2	0	2	2	1	2	1	15/22	68%	Mod
<b>Huebner (2002)</b>	Longitudinal Intervention Between & Within Subjects	1	0	0	2	2	0	0	N/A	2	2	2	11/20	55%	High
<b>Johnson (1990)</b>	Longitudinal Within Subjects	1	N/A	0	0	1	0	1	1	0	2	2	8/20	40%	High
<b>Kelly (2002)</b>	Longitudinal Between Subjects	2	2	0	2	2	2	2	2	0	2	1	17/22	77%	Mod

<b>Magee (2014)</b>	Longitudinal Within Subjects	1	N/A	0	2	2	2	0	N/A	0	1	1	9/18	50%	High
<b>McCullough (1999)</b>	Cross-Sectional Between Subjects	1	2	0	2	2	2	2	N/A	1	2	1	15/22	68%	Mod
<b>Mikhail (1995)</b>	Cross-Sectional Between Subjects	1	0	0	1	2	0	0	N/A	0	0	2	6/20	30%	High
<b>Nash (2013)</b>	Cross-Sectional Between Subjects	1	0	0	2	2	2	2	N/A	0	0	2	11/20	55%	High
<b>O'Connor (1992)</b>	Cross-Sectional Within Subjects	1	N/A	0	2	2	0	2	N/A	0	2	2	11/18	61%	Mod
<b>Pajulo (2012)</b>	Longitudinal Within Subjects	1	N/A	N/A	2	2	0	2	2	2	2	1	14/18	78%	Low
<b>Sarfi (2011)</b>	Cross-Sectional Between Subjects	1	1	0	2	2	2	0	N/A	0	2	1	13/20	65%	Mod
<b>Shieh (2006)</b>	Cross-Sectional Between Subjects	1	N/A	0	2	2	0	0	N/A	0	0	1	7/18	33%	High

\*Quality descriptors: 80-100% = low risk of bias (n = 1); 60-79% = moderate risk of bias (n = 7); 59% or below = high risk of bias (n = 8).

## Results

The 15 included studies represented 15 cohorts,  $N = 103$  pregnant women with current or historical SM,  $N = 619$  mother-infant dyads with current or historical maternal SM, and  $N = 387$  mother-infant dyads without current or historical maternal SM. Study designs were as follows: longitudinal between-subjects ( $n = 4$ ), longitudinal within-subjects ( $n = 3$ ), longitudinal interventions (within and between subjects;  $n = 2$ ), cross-sectional between subjects ( $n = 5$ ), and cross-sectional within subjects ( $n = 1$ ). Five studies reported outcomes pertaining to MFR, 11 reported MIR outcomes. Five studies reported outcomes regarding both MFR and MIR over time. Ten studies reported outcomes relating to infant health and wellbeing. Twelve studies were conducted in the USA, two in Finland, and one in Norway. All studies were published between 1990 and 2014. See Table 2 (pp. 21 – 38) for a summary of study findings. Sixteen measures were identified for MFR/MIR outcome variables, with several studies using more than one measure. See Table 4 (Appendix B, p.154) and Appendix B pp.155 – 156 for summaries of these measures.

### ***Maternal-fetal relationship quality & perinatal SM***

Five studies reported outcomes for MFR quality and maternal SM, three of which indicated that maternal SM may be associated with poorer quality of MFR (Magee et al., 2014; Mikhail, Youchah, DeVore, Ho, & Anyaegbunam, 1995; Pajulo et al., 2012). One study reported findings which suggested no relationship between quality of MFR and maternal SM (Shieh & Kravitz, 2006) while another reported conflicting findings (Goldman-Fraser, 1997). See Table 2 for study characteristics and findings.

Magee et al. (2014) and Mikhail et al. (1995) measured MFR quality using the Maternal Fetal Attachment Scale (MFAS; Cranley, 1981). Magee et al. (2014) found that poorer MFR quality was associated with higher salivary cotinine level (cotinine is the main nicotine metabolite produced by the liver and indicates degree of tobacco consumption). Women in Magee et al.'s (2014) study were separated into 'high' and 'low' MFR quality groups: women in the low MFR quality group smoked a greater maximum number of cigarettes per day than women in the high MFR quality group. In a cross-sectional study Mikhail et al. (1995) found that women with history of SM who were participating in a methadone maintenance programme ( $N = 17$ ) reported significantly lower MFR quality than comparison women, albeit with a small effect size. Taken together, these findings provide support for the argument that impairment of the caregiving system results in poorer emotional connection to the fetus and reduced desire/action to protect the fetus in utero (Sandbrook & Adamson-Macedo, 2004).

Goldman-Fraser (1997) and Pajulo et al. (2012) reported measures of maternal thoughts and beliefs (viewed as cognitive aspects of MFR quality) in reference to maternal SM. Goldman-Fraser (1997) reported a statistically significant difference between SM and comparison groups' prenatal beliefs about the impact of maternal substance misuse in pregnancy on child development in the prenatal and postnatal periods. Fewer SM women reported the belief that SM in pregnancy is harmful to child development. These findings may be due to poorer understanding regarding infant development and risks of SM in pregnancy within the SM sample (perhaps associated with general lower educational attainment), or it may be that SM women exhibited cognitive dissonance regarding their misuse of substances in pregnancy and the associated potential harm to the fetus. This type of cognitive dissonance may be made underpinned by temporary or enduring deactivation of their caregiving system (Solomon & George, 1996).

Pajulo et al. (2012) collected baseline data in pregnancy for SM women in their study of maternal reflective function. Reflective function has been defined as the capacity to "...understand behaviour in light of underlying mental states and intentions" (Slade, 2005, p269). Prenatal reflective function, measured by total Pregnancy Interview (PI) score, was found to be weak in the study sample of SM women. In the prenatal period only one mother had a "close to ordinary" total reflective score (Pajulo et al., 2012, p76). Elsewhere in the literature reflective functioning has been linked with more intense emotional attachment to the fetus (Foulkes, 2015), which may explain why two of the single items within the Pregnancy Interview (PI) which correlated most highly with overall reflective functioning score were "How did you feel when you found out you were pregnant?" ( $r = 0.84$ ) and, "Have you had good feelings about the pregnancy?" ( $r = 0.82$ ). These types of questions may be helpful to consider for naturalistic risk screening within clinical settings.

Two studies found no association between MFR quality and SM status. Shieh and Kravitz (2006) examined the relationship between MFR quality and type/severity of drug use. Participants were categorised either as marijuana users or cocaine/heroin users. Shieh and Kravitz (2006) reported that there was no significant difference between groups' MFR scores. Goldman-Fraser (1997) examined maternal self-efficacy, expectations of own parenting competence, and expectations of infant behaviour in SM and comparison women during their first pregnancy, and found no significant differences between groups, suggesting that participants had equal confidence in their parenting ability, regardless of the presence of risk factors such as SM. These findings call into question whether directly asking women about their confidence in their parenting ability or their estimation of how they will respond to their baby is a valid or reliable method of assessing parenting ability prenatally.

Overall, SM women appear to have poorer MFR quality than comparison women, which manifests in weaker emotional bonds, less positive/helpful thoughts and beliefs about the unborn child, and engagement in health behaviours which put the fetus at risk. There was no evidence to suggest that type and severity of SM is significant in relation to MFR quality. This group of studies was characterised by high heterogeneity in terms of MFR measures and type/severity of SM, in addition to three of the five studies having a high risk of bias rating (one study was rated as having a moderate risk of bias, and another a low risk of bias).

### ***Maternal-infant relationship quality & perinatal SM***

A total of 11 studies reported MIR outcomes in relation to maternal SM (Belt et al., 2012; Blackwell et al. 1998; Goldman-Fraser, 1997; Hogan, 2002; Huebner, 2002; Johnson & Rosen, 1990; Kelly, 2002; McCullough, 1999; Nash 2013; O'Connor, Sigman, & Kasari, 1992)., 1992; Sarfi, Smith, Waal, & Sundet, 2011). See Table 2 for study characteristics and findings.

Four studies (Belt et al., 2012; Blackwell et al. 1998; Nash, 2013; O'Connor et al. 1992) reported that poorer quality of MIR was related to maternal SM (current or historical). Belt et al. (2012) and Nash (2013) found that women with current or historical SM were less sensitive in maternal-infant interactions than comparison women. O'Connor et al. (1992) reported that greater severity of alcohol misuse during pregnancy was associated with subtle behavioural changes in infants' affect. The mothers of infants who displayed more negative affect were less responsive to their infants, and these infants displayed insecure attachment behaviour. The subtlety of the relationship between SM and maternal-fetal interaction was also highlighted by Nash (2013), who reported that incidence of dyadic mismatching during play in dyads who experienced prenatal alcohol exposure ranged from 41% to 97%, whereas dyadic mismatching ranged between 29% to 100% in the comparison group.

Blackwell et al. (1998) assessed maternal interaction using the Nursing Child Assessment Feeding Scale (NCAFS; Sumner & Spietz, 1994) from the Nursing Child Assessment Satellite Training (NCAST; Barnard, 1978). Echoing findings from other studies, Blackwell et al. (1998) reported that SM women had low NCAFS scores in comparison with scale norms; the majority of the sample's interaction quality fell within the 'at risk' range. At six months postpartum the quality of maternal interaction was significantly lower for the relapse group than the abstinent group (Blackwell, Kirkhart, Schmitt, & Kaiser, 1998). At six months 100% of the relapse group's maternal interaction scores were within the at-risk range, and 70% of the abstinent group's scores were also in that range. The findings of these five studies suggest that maternal SM is associated with poor MIR quality.

However, six studies reported no relationship between SM and maternal-infant relationship quality (Goldman-Fraser, 1997; Hogan, 2002; Johnson & Rosen, 1990; Kelly, 2002; McCullough, 1999; 2012; Sarfi et al., 2011). Hogan (2002) found no significant differences between SM women who were or were not engaging in SM treatment, as well as no difference between SM women and comparison women'

maternal-infant relationship quality. Goldman-Fraser (1997) and McCullough (1999) reported no clinically significant difference between the sensitivity of SM and comparison mothers, or their degree of involvement with their child. Johnson and Rosen (1990) found no correlation between intensity of maternal substance use and maternal responsiveness in mother-infant interactions. Goldman-Fraser (1997) also reported no clinically significant difference in maternal hostility or child responsiveness between SM and comparison groups. Sarfi et al. (2011) found no significant predictive effect of SM status on dyadic mutuality. Kelly (2002) found that there was no significant association found between maternal SM status and quality of the home environment.

In summary, the 11 studies (Belt et al., 2012; Blackwell et al., 1998; Goldman-Fraser, 1997; Hogan, 2002; Huebner, 2002; Kelly, 2002; Magee et al., 2014; McCullough, 1999; Nash, 2013; O'Connor et al., 1992; Sarfi et al., 2011) reporting outcomes of maternal SM and MIR quality identified conflicting results, both between and within each study. As a group, the four studies which reported a relationship between maternal SM and MIR quality were deemed to have higher risk of bias than the six studies which did not identify this relationship, which must be considered when interpreting results. There was also significant heterogeneity in the MIR quality indicators, outcome measures, and type, frequency, and severity of SM reported. Only one study which reported between groups comparison matched SM and comparison groups on demographic and socio-economic variables (McCullough, 1999). These methodological limitations make it difficult to interpret the relationship between perinatal SM and MIR quality. However, the finding that impairment in mother-infant interaction quality in the context of maternal SM is subtle (O'Connor et al., 1992; Nash, 2013) may suggest that maternal SM can be considered as a single cumulative risk factor in the context of other threats to the maternal-infant relationship, such as maternal stress, mental health difficulty, or socio-economic factors (Hatzis et al., 2017). This concept of SM as a part of a wider constellation of risk to MIR quality is supported by Sarfi et al.'s (2011) conclusion that individual differences were considered to be more influential on relationship quality than mothers' SM status.

### ***Maternal-fetal/infant relationship outcomes over time***

Five studies reported outcomes reflecting the longitudinal relationship between MFR and MIR, relative to maternal SM and other important outcomes (Goldman-Fraser, 1997; Magee et al., 2014; McCullough, 1999; Nash, 2013; Pajulo et al. 2012).

Pajulo et al. (2012) reported that prenatal and postnatal maternal reflective function were significantly correlated with a large effect size, although pre- and post-natal reflective function levels (generally reported to be 'weak' in comparison with norms) were not associated with maternal interaction quality (although interaction quality was generally characterised as 'weak'). For women whose children were later placed in foster care, pre- and postnatal reflective function scores were lower (statistically non-significant) than that of mothers who kept their children, which suggests that prenatal reflective function may be associated with postnatal caregiving quality, as have been reported elsewhere (Suchman et al., 2010). Further research which employs more robust methods (e.g., greater sample size, matched control groups of both general population women and women with mental health difficulties, use of standardised and validated measures of maternal-infant interaction) would be required to ascertain whether this trend signifies a meaningful relationship between reflective function and maternal-infant interaction/infant outcomes.

Goldman-Fraser (1997) measured the discrepancy between mothers' expectations of their infants' behaviour, and the rating of independent assessors. They reported greater discrepancy between SM mothers' and independent raters' than comparison mothers' and independent raters' assessments, suggesting that SM mothers are less accurate in their expectation and perception of their infants' behaviour: this may be reciprocally related to mother-infant interaction quality. A related finding from Johnson and Rosen's (1990) study showed little agreement between SM mothers' and independent observers' rating of infant temperament. This lack of agreement may suggest that i) SM directly negatively influences maternal perception of infant behaviour, ii) SM is part of an indirect relationship, i.e., elevated maternal stress increases likelihood of both negative perception of infant behaviour and SM, or iii) *in utero* exposure to substances negatively influences infant temperament (Schoeps et al., 2018). Findings such as Johnson and Rosen's (1990), that elevation of maternal SM (type and frequency) was associated with a decrease in maternal reports of 'easy baby' characteristics, need to be further scrutinised to understand the underlying mechanism(s) at play.



Two studies reported links between SM in pregnancy and postnatal mother-infant interaction. Goldman-Fraser (1997) reported that severity of maternal alcohol misuse in pregnancy was negatively correlated with maternal sensitivity, and positively correlated with greater hostility towards the child at three months post-partum, although this correlation was not deemed to be clinically significant. Goldman-Fraser (1997) suggest that this subclinical trend for diminished maternal sensitivity and greater maternal hostility within the SM sample may represent greater risk to substance-exposed infants, who are reported to require more attuned caregiving to support optimal development (Vélez & Jansson, 2008). Whilst Nash (2013) reported that prenatal alcohol exposure was related to more negative maternal-infant interaction, it was also reported that prenatally exposed groups and control groups showed a similar degree of positive engagement behaviours and levels of matched/mismatched dyadic interactions. This finding of an independent effect of prenatal alcohol exposure on positive and negative aspects of maternal-infant interaction highlights the importance of assessment of both types of interaction behaviours in research and during clinical assessment, as focus on one dimension will result in only partial understanding of the relationship between maternal SM and maternal-infant interaction.

Finally, Magee et al. (2014) found that smokers' low MFR quality in pregnancy were associated with higher salivary cotinine level at one day postpartum, indicating increased level of smoking in mothers with low MFR quality. This is suggestive of support for the theory that a positive MFR, as a product of the caregiving system, should be correlated with behaviours designed to protect and nurture the infant, both before and after birth.

These five studies report heterogeneous findings, however when taken together they imply that maternal SM in pregnancy is related to poorer MFR quality and less accurate understanding of infant behaviour. Women who misuse substances also appear to be less sensitive and appropriately responsive to their infants, display greater hostility in interactions, and may be more likely to engage in riskier health behaviours. A theme which deserves particular attention in future research is that of the cumulative effect of minor but consistent mismatching and misinterpretation of communication cues within the mother-infant relationship, which is known to be a risk factor for development of insecure attachment style in children (Tronick et al., 2005).

## ***Covariates of maternal-fetal/infant relationship quality***

### *Maternal age*

All studies bar one (Johnson & Rosen, 1990) reported participants' age. No overall trend was identified for age of SM mothers in comparison to women from the general population.

### *Maternal SES & ethnicity*

Across included studies, SM women were also likely to have low SES, captured by high rates of unemployment (Belt et al., 2012; Blackwell et al., 1998; Johnson & Rosen, 1990; Magee et al., 2014; Pajulo et al., 2012; Sarfi et al., 2011), low income (Kelly 2002; Magee et al., 2014; Nash, 2013); and receipt of state benefits (Blackwell et al., 1998; Huebner, 2002; Johnson & Rosen, 1990; Pajulo et al., 2012) found that 93% of SM women in their sample were in receipt of benefits, whereas this was true for only 21% of comparison women.

Kelly's (2002) finding that increase in HOME Environment scores correlated with a decrease in SES risks suggests that combined psychosocial risk factors such as low income, maternal education, and black and ethnic minority status are significantly related to MIR quality indicators.

Hogan (2002) reported that minority status was an important predictor of Nursing Child Assessment Teaching Scale scores (NCATS; Barnard, 1978), such that poorer mother-infant interaction was observed in African-American mothers. However, these findings must be interpreted carefully: a systematic literature review has identified that whilst parental sensitivity, measured by assessment tools such as the NCATS, is often reported to be lower in ethnic minority samples, this apparent difference between ethnic groups is explained by greater family stress in these groups due to socio-economic disadvantages (Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2012). Ethnicity minority status should therefore be conceptualised as a potential indicator of SES disadvantage or social stress, and be reported carefully to avoid prejudicial or discriminatory interpretation of such findings. Of the nine studies included in this review which reported ethnicity of participant samples, seven studies reported >50% black and ethnic minority participant samples (Blackwell, Kirkhart, Schmitt, & Kaiser, 1998; Goldman-Fraser, 1997; Hogan 2002; Kelly, 2002;

McCullough, 1999; Mikhail, Youchah, DeVore, Ho, & Anyaegbunam, 1995; Shieh & Kravitz, 2006). Of note, Shieh and Kravitz (2006) found that white participants reported more severe prenatal drug use than non-white participants. However, while there were no white participants within the marijuana use group, a third of the cocaine and heroin users were white, suggesting these findings are subject to selection bias.

### *Maternal education & social support*

A clear pattern emerged regarding maternal educational level and SM status. Five of the seven studies which measured educational attainment between groups reported that women with current or historical SM had lower educational attainment than comparison women (Belt et al., 2012; Hogan, 2002; Kelly, 2002; Nash, 2014; Sarfi, Smith, Wall & Sundet, 2011). The two remaining studies were methodologically atypical: Goldman-Fraser (1997) conducted a matched samples study and Huebner (2002) conducted a between-group analysis of an overall sample with very low socioeconomic status.

Maternal education level was a significant covariate for maternal non-hostile behaviour, with greater educational attainment being associated with more non-hostile behaviour (Belt et al., 2012). It was also a significant predictor of maternal NCATS scores (Hogan, 2002) and higher maternal postnatal reflective function (Pajulo et al., 2012).

Across the reviewed studies, there was a trend for SM women to be unmarried/single parents, although only Belt et al. (2012) and Goldman-Fraser (1997) identified a significant difference in marital status between SM and comparison women (with SM women being less likely to be married or in a committed relationship). More generally, Goldman-Fraser (1997) reported that SM women had poorer social support than comparison women both prenatally and postnatally. A related finding from Blackwell et al. (1998) indicated that 13% of the variance with regard to SM relapse was accounted for by (lack of) maternal social support.

### *Maternal psychological distress, abuse, & trauma*

Maternal psychological distress (e.g., anxiety and depression) is a known risk factor for poor MFR (Yarcheski et al., 2009) and MIR quality (Stein et al., 2014). Five studies reported maternal mental health outcomes in relationship to MFR/MIR quality and maternal SM (Belt et al., 2012; Goldman-Fraser; Nash, 2013; Pajulo et al., 2012; Sarfi et al., 2011). No clear pattern regarding psychological distress and SM has emerged from this review. Goldman-Fraser (1997) reported that SM women had higher rates of depression and stress than comparison women; high depression and stress were negatively correlated with prenatal knowledge of infant development and perception of infant behaviour. Nash (2013) found that women who drank alcohol to excess in pregnancy had slightly higher levels of past diagnosis and/or treatment for depression and symptoms of depression in the postnatal period, as well as greater incidence of life stressors, than control mothers.

Sarfi et al. (2011) found that women in opioid maintenance treatment and comparison women did not report psychological distress symptoms above the clinical cut-off on the Hopkins Symptom checklist (HSCL-25; Derogatis et al., 1974), although women in opioid maintenance treatment reported substantially higher overall psychological distress. However, Sarfi et al. (2011) reported that maternal psychological distress was not significantly associated with dyadic mutuality in either group across the perinatal period. Similarly, Pajulo et al. (2012) found that maternal psychiatric symptoms were not significantly associated with pre- and post-natal reflective function levels. It should be noted that none of the included studies employed a research design whereby the MFR/MIR outcomes of SM women were compared with those of women with mental health difficulties but no history of SM, meaning that the separate influence of these factors could not be delineated. Research studies which control for these differences will be key in developing understanding of the relationships between these variables.

Of interest, Belt et al. (2012) found that greater economic hardship was related to greater depressive symptomatology. This finding highlights the need to understand the context in which women are living and raising their children, as this might have implications for how maternal health and wellbeing (and consequently infant health and wellbeing) may be addressed at a systemic level.

Lifetime experience of abuse and trauma is linked to poor mental health (Merrick et al., 2017), and particular patterns of attachment style (Murphy et al., 2014) which are

related to suboptimal functioning of the caregiving system in parents (Suchman, Pajulo, DeCoste, & Mayes, 2006). Assessment of adult participants' lifetime experience of abuse/trauma was limited to two studies within this sample. Goldman-Fraser (1997) found that SM women were more likely to have experienced emotional, physical, and sexual abuse than comparison women, and Pajulo et al. (2012) found that experience of trauma was negatively associated with quality of reflective function in SM mothers across the perinatal period. Pajulo et al. (2012) reported that greater exposure to physical abuse and secrets within the family in early childhood, respectively, corresponded to less positive change in reflective function during the intervention. In addition, the more the mother had experienced family secrets, physical and emotional abuse, or neglect during her lifetime, the less positive change in reflective function was observed during the intervention.

#### *Inter-related covariates of MFR/MIR*

Across studies, several covariates of MFR/MIR quality were reported to correlate with each other. Goldman-Fraser (1997) found that maternal prenatal knowledge of infant development was negatively related with maternal experience of abuse and stress levels, and positively related with symptoms of depression. Likewise, degree of SM in pregnancy was reported to be inversely related to perception of infant behaviour, maternal experience of abuse, and maternal stress at three months postpartum. Johnson & Rosen (1990) found that mothers' rating of infant temperament was positively correlated with maternal responsiveness; mothers who displayed more constructive interactions with their infants were more likely to report on their infants' positive responses. Kelly (2002) found that the less contact a father had with their child, the more SES risks the mother-child dyad experienced. More SES risks were associated with poorer quality of the home environment (Kelly, 2002). Together these findings build up a picture of complex interactions between interpersonal and systemic risk factors for the wellbeing of mother and child.

## ***Infant outcomes***

### *Infant health & wellbeing outcomes*

Of the 10 studies that reported general infant health outcomes (Belt et al., 2012; Blackwell et al., 1998; Goldman-Fraser, 1997; Hogan, 2002; Kelly, 2002; Magee et al., 2014; McCullough, 1999; O'Connor et al., 1992; Pajulo et al., 2012; Sarfi et al., 2011), few physical differences were identified at birth between infants prenatally exposed to substances and comparison infants. This is notable, given previous findings that infants who are prenatally exposed to substances have a greater likelihood of being born prematurely and having a low birth weight (Mayet et al., 2008; Havens, Simmons, Shannon, & Hansen, 2009). This may be a function of the comparison infant cohorts' tending to represent low SES samples, whereby other factors such as nutritional deficiencies and nutritional stress may reduce birthweight.

Goldman-Fraser (1997) found no significant differences in postpartum health outcomes for infants, although a trend for poorer health outcomes in the substance exposed group was noted, although severity of SM did significantly correlate with infant health problems (Goldman-Fraser, 1997). Better postpartum infant health was significantly correlated with more positive maternal perceptions of infant behaviour and greater maternal social support, and inversely related to maternal experience of all forms of abuse, depression, and stress. Sarfi et al. (2011) found that comparison group infants were significantly heavier than opioid-exposed infants, but both groups were within normal limits, and both groups had a mean gestational age within the normal range.

Importantly, there were some indications that general infant health outcomes may be related to quality of maternal-infant interaction. Sarfi et al. (2011) found that dyadic mutuality was significantly associated with infant birth weight, and Magee et al. (2014) found that, of a sample of women who smoked, those who reported poorer MFR quality had infants with lower birth weight. This means that studies which report longer follow-up periods are likely to be more informative regarding infant health outcomes.

### *Infant cognitive & psychomotor development*

Of the four studies which assessed infant cognitive development, three reported that substance-exposed infants had poorer outcomes than comparisons (Blackwell, Kirkhart, Schmitt & Kaiser, 1998; Goldman-Fraser, 1997; Sarfi et al., 2011), although this difference resolved over time in one study (Blackwell et al., 1998). Pajulo et al. (2012) reported that all substance-exposed infants showed development within normal limits at four months of age. It is notable that Pajulo et al. (2012) reported data from an intervention study which aimed to improve MIR and maternal-infant interaction quality, raising the question of whether improved MIR quality as a result of support buffers against the effect of prenatal substance exposure.

Of note, Blackwell et al. (1998) reported that infant cognitive development was significantly positively correlated with MIR quality at both four and six months postpartum. Goldman-Fraser (1997) found that infant cognitive development was negatively correlated with maternal experience of abuse (prenatally and postnatally), maternal prenatal stress, and maternal hostility. These findings suggest that quality of the MIR and the mothers' own experience is of considerable importance in supporting infant cognitive development.

### *Infant behaviour/interactional quality*

Two studies measured infant behaviour/maternal-infant interaction quality in relation to prenatal substance exposure. Substance exposed infants were rated as more 'difficult' by objective observers (Goldman-Fraser, 1997); 'difficultness' was related to maternal sensitivity, which this study also identified as being inversely correlated with SM (Goldman-Fraser, 1997). Nash (2013) found infants prenatally exposed to alcohol were judged to be more dysregulated than controls (as rated by their mothers), and that independent raters judged infants prenatally exposed to alcohol to have a higher mean 'fear' score (indicated by greater startle response or distress following sudden changes in stimulation, novel physical objects, or social stimuli, as well as an inhibited approach to novelty). Nash (2013) linked this elevated 'fear' mean score to greater incidence of mismatching in dyadic interactions.

One study reported findings regarding the effect of maternal abstinence or relapse on the MIR in the first six months of life (Blackwell et al., 1998). Counter-intuitively, at

four months postpartum mother-infant dyads who experienced relapse displayed no differences on the maternal/infant subscales of the NCAFS in comparison with mothers who remained abstinent. However, at six month follow-up the mothers who experienced relapse had significantly poorer interaction with their infants than those who remained abstinent. It is not known whether this is a function of the mothers' continued SM between four and six months post-partum, or if it is symbolic of a different, yet related, underlying difficulty (e.g., greater maternal distress which leads to SM as a coping mechanism). It is notable that 13% of relapse variance was accounted for by level of maternal social support available. Overall this finding signifies the importance of longitudinal measures to accurately understand the impact of maternal substance use (and covariates) in the post-partum period on infant development.

#### *Infant attachment*

Three studies measured infant attachment security in relation to prenatal substance exposure. In a sample of substance exposed infants (O'Connor et al., 1992) 50% were classified as having a secure attachment style, 14% as insecure-avoidant, 5% as insecure-ambivalent, and 32% as disorganised; within this sample of substance-exposed infants there was lower incidence of secure attachment than in the general population (Ainsworth, Blehar, Waters, & Wall, 1978). Kelly (2002) assessed the attachment security of substance exposed and comparison children (using the Strange Situation procedure) at 18 months old, and reported that maternal SM status was significantly associated with attachment security: children whose mothers were continuing to use substances were more likely to have an anxious attachment pattern than those with abstinent mothers or with mothers who had never used substances. No significant difference in the proportion of dyads with disorganised attachment was found between groups. Conversely, McCullough (1999) identified that alcohol exposure in the first and second trimester significantly predicted greater attachment security over time, and accounted for greater variance in attachment security than cocaine use, maternal involvement, or maternal sensitivity. The authors hypothesised that this finding was a function of women attempting to replace illicit drugs with alcohol, due to their desire to act in the best interests of their child.



## **Methodological sources of bias in the literature**

### *Sampling & design*

Of the 15 cohorts represented in this review, nine were longitudinal studies (Belt et al., 2012; Blackwell et al., 1998; Goldman-Fraser, 1997; Hogan, 2002; Huebner, 2002; Johnson & Rosen, 1990; Kelly, 2002; Magee et al., 2014; Pajulo et al., 2012) which provided information regarding the long-term relationships between maternal SM in the perinatal period and MFR/MIR. There was considerable variation in data collection time frames across these studies, which compromises the confidence with which conclusions can be made regarding the longitudinal relationship between the MFR and MIR within SM populations.

Eight studies reported outcomes from women with current or historical SM and comparisons. Of these studies, four reported demographic and socio-economic similarities between SM and comparison groups (Goldman-Fraser, 1997; Hogan, 2002; Kelly, 2002; Mikhail et al., 1995), and four studies reported substantial differences (Belt et al., 2012; Huebner, 2002; Nash, 2013; Sarfi et al., 2011). Therefore the certainty with which we can conclude that the differences between groups on MFR/MIR outcomes is due to the presence or absence of maternal SM (as opposed to other psychosocial risk factors) in the perinatal period is diminished. Sample sizes between studies varied significantly, from  $n = 18$  (Nash, 2013) to  $n = 198$  (Kelly, 2002), however the majority of studies relied on small sample sizes, meaning that the possibility of type two error is elevated.

### *Risk of bias interpretation*

As a whole, the included studies present substantial risk of bias (Table 3, pp.36-37). This largely arises as a function of the nature of recruitment issues regarding the SM population. Only two studies were rated as having unbiased selection, reflecting that the majority of studies were restricted by opportunity sampling of women who were willing to engage with services for treatment and inclusion in research. Likewise, most of the studies employing between subjects designs were unable to use matched sampling procedures to minimise baseline differences. Groups either represented different types of SM population, or studies recruited a comparison group the general population, with minimal effort to match on socio-demographic factors. Sample size calculation was not reported for any study, which is likely to reflect the mostly small sample sizes researchers were able to recruit; the majority of studies were under-powered. However, the majority of studies provided adequate cohort descriptions, used appropriate MFR/MIR and SM outcome measures, used appropriate analyses, and controlled confounding variables where possible.

### *Assessment of maternal-fetal relationship quality*

Factors identified as the cognitive aspects of MFR in this review were loosely defined, including beliefs and knowledge of infant development and health and safety practices associated with infant care, and maternal self-efficacy/expectations of parenting competence (for a summary of measures see Appendix B, Table 4, pp.154 and pp.155 – 156). Assessment of the emotional/relational aspects of MFR was more homogenous, with three studies employing MFAS (Cranley, 1981), and one using the PI (Slade et al., 2002), heterogeneity of the constructs related to MFR and the measures used to assess them reduces the certainty with which conclusions can be made regarding quality of MFR in the context of maternal SM.

### *Assessment of maternal-infant relationship quality*

All 15 studies used observational measures to assess quality of mother-infant interaction (an indicator of MIR quality; see Appendix B, Table 4, pp.154). There was high heterogeneity between observational measures, with only two pairs of studies using the same measures: Belt et al., 2012; Goldman-Fraser, 1997 used the Emotional Availability Scales (EAS; Biringen, 2008), and Huebner (2002) and Kelly (2002) used the Home Observation Measurement of the Environment Inventory (HOME; Caldwell & Bradley, 1984). All other studies used different outcome measures to assess mother-infant interaction (Appendix B, Table 4, pp.157 – 160). Consequently, comparing outcomes across studies is less robust. The studies which used the EAS reported that SM women had lower EAS scores at all time points when compared with controls (Belt et al., 2012; Goldman-Fraser, 1997), although these differences were deemed clinically non-significant in one study (Goldman-Fraser, 1997).

In addition to assessing mother-infant interaction, two studies measured other facets of MIR: McCullough (1999) assessed infant attachment style within the first 12 months postpartum, and Pajulo et al. (2012) conducted the Pregnancy Development Interview-Revised semi-structured interview (PDI-R; Slade et al, 2002) to understand the mothers' emotional relationship to, and view of, her infant. Again, the high heterogeneity of the measures used to assess MIR (which reflect overlapping yet different constructs) compromises the validity of comparison of the studies' findings as a group, and also reduces the confidence with which conclusions can be drawn about quality of MIR in the context of maternal SM.

### *Variance in substance misuse definition and measurement*

There was significant variance in definition of SM across studies, and type of primary substance used in single SM (e.g., tobacco, alcohol, marijuana, cocaine, and heroin) in addition to some studies including polysubstance misusers. The majority of studies relied on self-report measures regarding SM, which may result in under-reporting of SM/omission of information regarding types of substances used. Studies also varied in terms of whether SM groups were currently using substances or were abstinent and/or on medical treatment programmes. All these factors could create significant variance in MFR/MIR outcomes.

## Discussion

The aims of this systematic review were to 1) examine the current evidence for impairments in the MFR/MIR, 2) identify covariates, 3) identify possible associations with infant health and wellbeing outcomes, and 4) ascertain sources of bias within the literature base. Narrative synthesis of the 15 included studies identified significant variability in the findings pertaining to MFR/MIR quality in women with current or historical SM. Caution must be taken when drawing conclusions from the findings of these studies, due to their methodological heterogeneity and small sample sizes.

This review identified that SM women tend to have poor MFR quality in general (Magee et al., 2014; Pajulo et al., 2012), and in relation to comparison women in particular (Goldman-Fraser, 1997; Mikhail et al., 1995), although SM type/severity was not found to be a significant factor (Shieh & Kravitz, 2006). These results appear to provide support for the hypothesis that operation of the caregiving system may be impaired in SM women. Of note, assessment of the cognitive components of MFR has not been the focus of much research in the literature to date, although the Prenatal Caregiving Experiences Questionnaire (PCEQ; unpublished instrument, Brennan & George, 2013) assesses this construct and is currently being validated. The Caregiving Experiences Questionnaire (CEQ; Brennan, George, & Solomon, 2013) has been shown to be a valid and reliable method of assessing caregiving cognitions in the postnatal period (Røhder, George, Brennan, Nayberg, Trier, & Harder, in press). Future use of measures which assess the cognitive aspects of the MFR will be valuable.

Findings are less clear for studies reporting MIR quality. In the context of maternal historical or current SM, maternal-infant interaction appears to be subtly negatively affected in terms of biased perception of infant behaviour (Johnson & Rosen 1990), and risky maternal interaction style (Blackwell, Kirkhart, Schmitt, & Kaiser, 1998). It is also characterised by reduced maternal sensitivity (Belt et al., 2012; Huebner, 2002; Nash, 2013), increased maternal hostility (Goldman-Fraser, 1997) and dyadic mismatching (Nash, 2013). Consequently, miscommunications in MIR may be part of a cumulative risk effect, whereby a constellation of biopsychosocial risk factors negatively influence mother and infant as individuals and as a dyad.

As well as experiencing increased psychosocial risk, substance-exposed infants are more vulnerable to the negative impact of psychosocial risk factors on their cognitive and behavioural development than non-exposed children (Yumoto, Jacobson, &

Jacobson, 2008). The findings of this review highlight that MIR quality can ameliorate the developmental impact of prenatal substance exposure (Pajulo et al., 2012), and influence infant attachment style (Kelly, 2002; O'Connor, Signman, & Kasari, 1992), which itself can confer risk or resilience across the lifespan (Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016; Moreira, Gouveia, Carona, Silva & Canavarro, 2015; Siddiqui & Hägglöf, 2000). The psychosocial covariates of the maternal caregiving system are therefore key when considering maternal and infant wellbeing in the perinatal period.

This review identifies a range of important maternal psychosocial covariates of MFR/MIR quality in the context of maternal SM, particularly low SES (Belt et al., 2012; Huebner, 2002; Johnson & Rosen, 1990; Kelly, 2002; Magee et al., 2014; Nash, 2013; Sarfi et al., 2011), ethnic minority status (Blackwell, et al., 1998; Goldman-Fraser, 1997; Hogan, 2002; Kelly, 2002; McCullough, 1999; Mikhail et al., 1995; Shieh & Kravitz, 2006), low educational attainment (Belt et al., 2012; Hogan, 2002; Kelly, 2002; Goldman-Fraser 1997; Nash, 2013; Sarfi et al., 2011) and poor social support (Belt et al., 2012; Blackwell, et al. 1998; Goldman-Fraser, 1997). These findings are consistent with the general literature on psychosocial risk factors and vulnerability in the caregiver-infant dyad (Hatzis et al., 2018), with maternal SM an additional risk to the MIR quality within this context of psychosocial and interpersonal vulnerability (Yumoto, Jacobson, & Jacobson, 2008).

#### *An attachment & caregiving systems framework*

Caregiving and attachment systems may provide a useful framework for understanding how the biopsychosocial risks and vulnerabilities experienced by SM women may affect MFR quality, and subsequently MIR quality (see Figure 2, p.68). SM women are more likely to experience a range of psychosocial stressors in their lifetimes including adverse childhood experiences (ACEs), trauma, mental health difficulties, interpersonal violence, poverty, poor education and low SES (Kilpatrick, Acierno, Saunders, & Best, 2000; Murphy et al., 2014; White & Widom, 2008; Yoon, Kobulsky, Yoon, & Kim, 2017).

The relationships (emerging from the findings of this review) between on-going environmental stressors experienced by mothers, consequent activation of the maternal attachment system, and maternal efforts to manage their associated distress (which may have the unintended consequence of derailing the optimal functioning of her caregiving system; George & Solomon, 2008) are schematically represented in Figure 2 (p.68). If this pattern is chronic, it is likely to result in impaired development of the MFR, with further implications for MIR quality and long-term maternal and child outcomes (George & Solomon, 1999). These hypothesised relationships between variables are well-supported in the literature, particularly by findings which explain SM as a self-regulation strategy in individuals who have experienced abuse, trauma, and mental health difficulties, and identify current life stress as a mediating factor between ACEs and SM (White & Widon, 2008; Yoon, Kobulsky, Yoon, & Kim, 2017). Yoon, Kobulsky, Yoon, & Kim (2017) also reported that maternal experience of emotional abuse and neglect was significantly associated with poor MIR quality. In addition, Figure 2 suggests that maternal SM may directly impact on the caregiving system structure and function by affecting the thoughts, feelings, and behaviours relating to the unborn baby (Rutherford et al., 2011). Figure 2 also demonstrates how aspects of infant temperament may activate the maternal attachment and caregiving systems (likely to be characterised by insecurity or disorganisation; Murphy et al., 2014), and consequently influence MIR quality.

The findings of this review conceptualise SM women as a vulnerable population, likely to have experienced significant psychosocial adversity and interpersonal trauma throughout their lives, which are associated with the development of insecure and disorganised attachment styles, and unhelpful self-regulation strategies. Overall, findings suggest that the constellation of psychosocial risk factors within which SM women are likely to live pose substantial risks to their own wellbeing, and consequently that of their baby, due to the strain placed on the MFR/MIR. Negative MFR quality/MIR quality can play a part in the intergenerational transmission of attachment style and trauma (Alhusen, Hayat, & Gross, 2013), which have long-term implications for infant health and development (Slade, Bernbach, Grienenberger, Levy, & Locker, 2004).

**Figure 2: Attachment and caregiving behavioural systems framework of MFR/MIR**

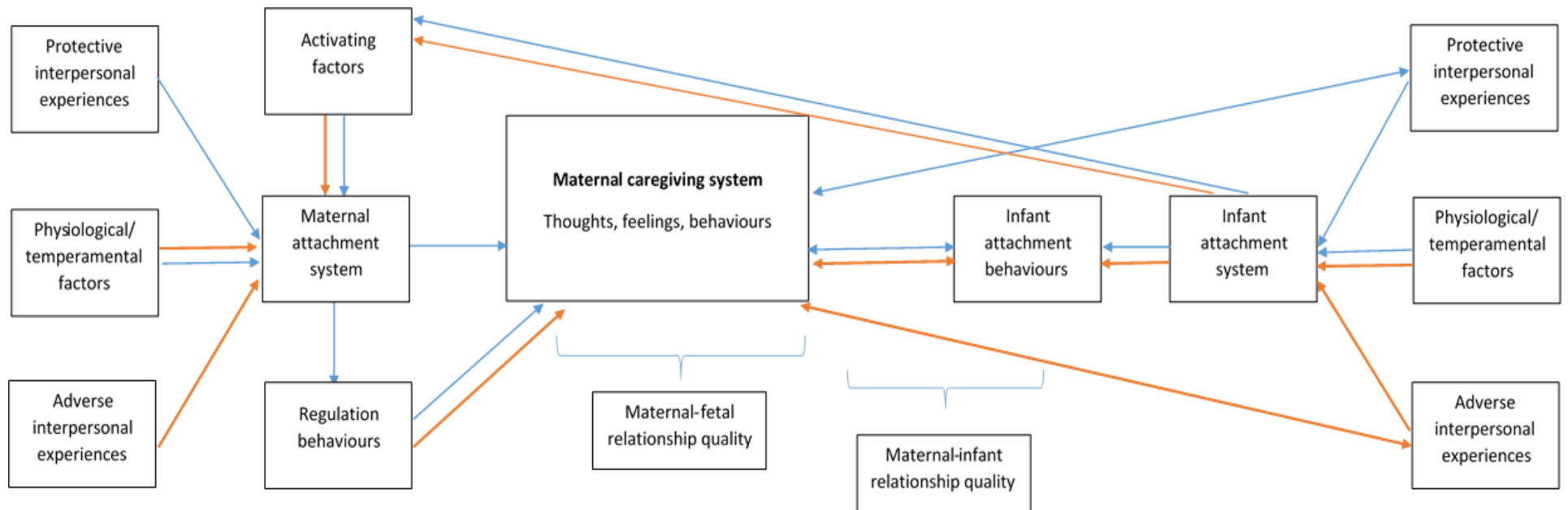


Figure 2 details the hypothesised positive (blue arrows) and negative (orange arrows) relationships between a range of psychosocial variables and the development/activation of the maternal attachment and caregiving systems, and the development and activation of the infant attachment system. The structure and function of the maternal caregiving system gives rise to the MFR. The direct interaction of the maternal caregiving and the infant attachment systems produces the MIR.

## **Limitations & implications for further research**

The studies included in this review are subject to significant risk of bias, due to small sample sizes and a lack of rigour in selecting comparison groups/using comparison groups to control for confounding variables such as maternal mental health difficulties. Further issues include substantial variance in the timing of pre- and post-natal outcome measurement across studies, and the use of many different outcome measures to assess different aspects of MFR/MIR quality and SM. All of these limitations mean that the findings of this review should be considered preliminary, and subject to change in light of more methodologically robust research which may emerge in the future.

This review has captured all currently available research reporting on MFR/MIR quality in SM women during the perinatal period. This is not a new area of research, with the oldest study in this sample dating from nearly thirty years ago (Johnson & Rosen, 1990). Since 1990, however, only ten studies have been published in peer-reviewed journals and a further five unpublished theses/dissertations have been conducted on this topic. From the small sample sizes of all the included studies, it is reasonable to conclude that pregnant women with current or historical SM are a difficult population to engage in intervention and research due to fear of stigma and punishment (Elms, Link, Newman, & Brogly, 2018). It may be that researchers, professionals, and services have been willing to accept that this population is 'hard to reach' because of the stigma surrounding SM women, and the lack of awareness of the potential for positive change for these women and their children (Latsukie et al., 2018; Stone 2015). It is also notable that SM frequently belong within intersecting social categorisations of deprivation. More research which investigates the inter-related constellation of biopsychosocial risk factors which affect mother-infant dyads within these groups is called for, in order to support the development of effective health and social care interventions and treatments.

Fortunately, there is evidence that existing psychosocial interventions are effective in supporting SM women to reduce their SM or become abstinent (Andrews et al., 2018), and improve the quality of their relationship with their child in their early years (Suchman, Coste, Mahon, & Dalton, 2017), which in turn is associated with a host of positive outcomes for both mother and baby (Barlow et al., 2019). It is imperative that health professionals are able to overcome the barriers to provision of these essential services to this at-risk population – both fiscal and prejudicial – in wider society



(Fortson, Klevens, Merrick, Gilbert, Alexander, 2016). Given that the existing data suggest that, without intervention, intergenerational transmission of risk and vulnerability in this population is inevitable (Schofield, Lee, & Merrick, 2013), more must be done to address this long-standing psychological and physical public health crisis. In the context of awareness-raising regarding ACEs and the intergenerational transmission of trauma and its multifactorial impact on health and wellbeing (Bellis et al., 2015), we should not ignore the opportunity to research, understand, and intervene in the perinatal period – the earliest possible point of early intervention (Bauer, Parsonage, Knapp, Lemmi, Adelaja, 2014). Whilst substantial vulnerability and risk can occur within relationships, the damage caused can be healed within relationships (Treisman, 2017). The earlier the intervention, the greater the potential positive impact, reduction of human suffering, and social and economic benefit (Bauer, Parsonage, Knapp, Lemmi, Adelaja, 2014). Therefore, when developing intervention plans for working with vulnerable women in the perinatal period, thought must be given to the systems in which they operate. Clinical assessment of risk and delivery of interventions will only be effective if professionals are given the time and flexibility to develop meaningful relationships with people who are – naturally and appropriately – wary of interpersonal relationships. In other words, systems must be supported to allow the delivery of trauma-informed practise (Elliott, Bjelajac, Fallot, Markoff, & Reed, 2005).

The majority of studies included for review were rated as ‘high’ or ‘moderate’ risk of bias, with only one study rated as ‘low risk’ of bias. In order to more accurately understand this complex area, larger-scale, methodologically robust studies must be conducted. Creative solutions must be developed to address the difficulty in recruiting this population for research purposes. One such idea is to harness the use of ‘big data’ in the form of routine measures completed by specialist health and social care professionals who have managed to engage SM women in the perinatal period (Hollis et al., 2015). In the UK context, examples of these would be NHS specialist substance use midwifery services, child and family social workers, and third sector agencies who support parents who use substances, for example NSPCC and Barnardos.

## **Conclusion**

SM appears to be part of a constellation of maternal and infant biopsychosocial risk factors linked to sub-optimal MFR/MIR quality. These have corresponding implications for parental caregiving practices, infant attachment security, and longer-term child health, wellbeing, and developmental outcomes. This systematic review and narrative synthesis highlights the relative scarcity of research regarding the link between MFR/MIR and maternal SM within the perinatal period, and the limitations of the existing literature; but supports a caregiving/attachment framework (Figure 1), as a useful model for understanding how biopsychosocial risk factors may interact to influence MFR/MIR quality, and longer term infant health and developmental outcomes. The perinatal period is a key point of assessment and intervention when working to address intergenerational transmission of risk in this vulnerable population. Health and social care structures thus need to be equipped accordingly.

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## Original Research Article

**Title:** Thinking about your baby: maternal caregiving representations, maternal-fetal relationship quality, and psychosocial risk factors in the second trimester of pregnancy

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## **Abstract**

Maternal-fetal relationship (MFR) quality is known to predict maternal-infant relationship (MIR) quality. Positive MIR quality is a protective factor across the lifespan, and is associated with positive development, health, and wellbeing outcomes throughout life. MFR quality is influenced by individual and environmental factors, with evidence suggesting that women experiencing depression and substance misuse difficulties, or who psychosocial risk factors such as abuse and social deprivation, may have increased vulnerability to suboptimal MFR quality. Prenatal maternal caregiving representations have been identified as cognitive indicators of MFR quality. This study explores the associations between maternal attachment security, caregiving representations, and MFR quality. It also investigates the relationship between maternal depressive symptoms and maternal attachment style, caregiving representations, and MFR quality. Finally, the associations between maternal psychosocial risk, attachment security, caregiving representations, and MFR quality are examined. A cross-sectional questionnaire study of 172 women in the second trimester of pregnancy recruited from the general population identified a number of significant psychosocial covariates of MFR quality (cognitive and affective aspects). Disorganised maternal caregiving representations characterised by dysregulation significantly predicted suboptimal MFR quality. Disorganised maternal caregiving representations characterised by dysregulation were found to partially mediate the relationship between maternal attachment avoidance and MFR quality. Likewise, secure organised caregiving representations were found to partially mediate the relationship between maternal avoidant attachment style and MFR quality. Development of brief validated scales to assess prenatal maternal caregiving representations may have implications for improving perinatal mental health care. Cognitive therapy may be an effective approach for improving security and organisation of caregiving representations, and thus MFR quality.

## Introduction

Maternal-infant relationship (MIR) quality is important for optimal child development (Siddiqui & Hägglöf, 2000); suboptimal MIR quality is associated with poorer child outcomes (van IJzendoorn, Dijkstra & Bus; 1995) and maternal distress (Harder et al., 2015). There are a number of mechanisms implicated in MIR quality, such as parental attachment and caregiving systems (George & Solomon, 1996), infant characteristics (Schoeps et al., 2018) and attachment behaviours (Cassidy, 2016), and psychosocial variables (Lanza, Rhoades, Greenberg, & Cox, 2011).

### *The attachment system*

Attachment theory denotes a behavioural system (comprising cognitive, emotional, and behavioural factors) shaped by evolution to enable infants to engage in protection- and proximity-eliciting behaviours, thus promoting their survival (Bowlby, 1973; Cassidy, 2016). The structure of this system informs its' function – the way in which infants seek to have their basic needs met (George & Solomon, 1996). Infant attachment organization is associated with developmental outcomes across a child's lifetime, with greater security related to reduced likelihood of developing mental health problems in later life, improved developmental outcomes, and good physical health (Adshead & Guthrie; 2015; Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016; Moreira, Gouveia, Carona, Silva & Canavarro, 2015; Siddiqui & Hägglöf, 2000; van IJzendoorn, Dijkstra & Bus; 1995).

The predominant model for these relationships is one of contextual risk: the protective aspects of secure attachment or the vulnerabilities associated with insecure/disorganised attachment exert more influence within the context of psychosocial factors such as social support, deprivation, traumatic life events, and physical illness (Belsky & Fearon, 2002; Belsky & Pluess; 2009; Fonagy & Target, 2005). Meta-analysis indicates that insecure and disorganised attachment styles in children are significantly related to externalising problems, with small to medium effect sizes (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010). Meta-analytic findings also indicate associations between anxious attachment style and internalising problems in childhood, albeit with small effect sizes (Groh, Roisman, van IJzendoorn, Bakermans-Kranenburg, & Fearon, 2012).

### *The caregiving system*

Similar to the attachment system, the caregiving system is a behavioural system which organises and regulates (via emotions and cognitions) caregiving behaviours that protect and nurture the child, thus promoting survival and optimal development (George & Solomon, 2008). Bowlby theorised that the caregiving and attachment systems were reciprocal, and developed in tandem (Cassidy, 2016). The quality of parental caregiving influences the child's understanding of herself, others, and the world around her, and how to effectively communicate her needs and elicit the most helpful responses from her caregivers. The type of care a child receives influences the organisation of the child's attachment system (George & Solomon, 2008). The operation of the parental caregiving system is influenced by many variables, including individual/intrapersonal (e.g., thoughts, feelings, hormonal and physical changes, and the parent's own attachment system), and environmental/interpersonal factors (e.g. presence or absence of stressors and supports such as food, warmth, money, physical and psychological safety, and a social network).

In terms of these individual factors, the nature of the parent's attachment system is particularly important. The parental caregiving system operates within the context of the attachment system, which is continuously active – monitoring the environment to ensure that the correct degree of exploration and safety behaviours are enacted (Jones, Cassidy, & Shaver, 2015). These authors suggest that while a child's attachment behaviour is intended to activate the parent's *caregiving* system, it is also possible for it to unintentionally activate the parental *attachment* system. Indeed, if a parent's attachment system has been primed (through life experience) to interpret the initiation of emotional or physical closeness by another person as a threat, then it is possible that their child's attachment behaviours (e.g., crying, reaching out for comfort) may be experienced as a threat, leading to arousal of the parental attachment system. How the parent regulates this aversive experience is of vital importance regarding the quality of their caregiving. If the parent's method of regulation is based on an avoidant attachment style, they are likely to withdraw from interaction with their child (deactivation of the caregiving system; George & Solomon, 2008). Parental anxious attachment will result in inconsistent responses (disconnection of the caregiving system; George & Solomon, 2008). Parental disorganised attachment is associated with dysregulated/constricted styles of caregiving (George & Solomon, 2008). The type of care a child receives informs their

own attachment style (van IJzendoorn, 1995), thus the attachment style of a parent may be transmitted to their child via the structure and function of their caregiving system (George & Solomon, 1996). This intergenerational transmission can be viewed as a product of individual and environmental factors (Fonagy & Target, 2005).

Individual and intrapersonal stressors to the adult attachment system may include mental health difficulties, such as depression, stress, and post-traumatic stress disorder, which have all been linked with attachment insecurity (Aptkinson et al., 2000; Moran & Bernazzani, 2002; Woodhouse, Ayers, & Field, 2015). Substance misuse (which can be conceptualised as an emotion regulation strategy; Hien, Cohen, & Campbell, 2005) is also linked to insecurity and disorganization of adult attachment systems (Schindler, Thomasius, Petersen, & Sack, 2009). Importantly, interpersonal and environmental stressors such as ACEs, poverty/deprivation, poor educational attainment, unemployment, homelessness, ethnic minority status, abuse, mental health difficulties, and substance misuse are significantly inter-related (Kilpatrick, Acierno, Saunders, & Best, 2000; Murphy et al., 2014; White & Widom, 2008; Yoon, Kobulsky, Yoon, & Kim, 2017). This pattern of cumulative risk suggests that women who experience individual and environmental stressors during pregnancy, and particularly those who have an insecure or disorganised attachment style, may be at greater risk of engaging in emotion regulation strategies which could impact on the functioning of the caregiving system and implementation of optimal caregiving behaviours, precipitating poorer MIR quality.

### *The caregiving system in pregnancy*

During pregnancy, the caregiving system commences a 'bio-social-behavioural shift', a term encapsulating changes in self-identity (emotional and cognitive) as well as hormonal and neurological changes (George & Solomon, 2008). Whilst factors such as the birth experience and the nature of the baby are known to influence the quality of the maternal-fetal relationship and the mother's caregiving behaviours, George and Solomon (2008) state that,

The mother's perception of her infant and of their relationship appear to be more important factors than any single quality of the baby ...her perceptions are likely to be...heavily influenced by other factors associated with the mother herself, including her memories and feelings about her own childhood attachment experiences.  
(pp.351-852).



Activation of the caregiving system triggers thoughts, feelings, and behaviours evolved to optimise physical wellbeing of mother and the fetus (Sandbrook & Adamson-Macedo, 2004). This hypothesis is supported by meta-analysis indicating that maternal-fetal relationship (MFR) quality significantly predicts (with a large effect size) positive maternal health practices during pregnancy (Cannella, Yarcheski & Mahon, 2018).

The thoughts and feelings experienced by the mother-to-be prompt different types of protective and nurturing behaviour towards the fetus, initially referred to as maternal-fetal attachment; originally defined as "...the extent to which women engage in behaviours that represent an affiliation and interaction with their unborn child" (Cranley, 1981, p. 282). Subsequent definitions converge around the common theme of maternal fetal attachment as an emotional bond experienced by the mother, which links her to her unborn child. However, Walsh (2010) identified a conceptual problem with terming this maternal-fetal bond at an 'attachment' relationship, as it refers to the emotional link a mother feels towards her baby which is characterised by a strong desire to protect and nurture arising from activation of the *caregiving* system, rather than a motivation to seek comfort or protection from the infant, arising from the *attachment* system. Therefore, this bond may be more aptly defined as the 'maternal-fetal relationship' (MFR; Walsh 2010). MFR quality has been associated with infant developmental outcomes (Branjerdporn, Meredith, Strong, & Garcia (2017).

Affective/relational aspects of the MFR are predictive of postnatal relationship quality and positive caregiving behaviours (Siddiqui & Hagglof, 2000; Taffazoli, Asadi, Aminyazdi, & Shakeri, 2015). In addition, maternal prenatal caregiving representations (the cognitive aspect of MFR) correlate with both postnatal maternal representations and mother-infant attachment (Vreeswijk, Maas, Van Bakel, 2012). Specifically, non-balanced prenatal representations of the unborn child were found to be associated with greater insecurity in the postnatal attachment relationship (Vreeswijk, Maas, Van Bakel, 2012).

### *Caregiving representations*

George and Solomon (2008) propose that there are two main types of caregiving representations – organised and disorganised – and that these types of caregiving representations arise from the parent's attachment organisation. Organised secure attachment gives rise to caregiving representations characterised by 'flexible integration'; flexible and integrated caregiving representations correlate with parental behaviours associated with infant attachment security, and secure infant attachment itself (George & Solomon, 2008). Insecure avoidant attachment is hypothesised to relate to a tendency within the parent to try and "remove distress from conscious awareness" (George & Solomon, p.858), by downregulating the attachment system when activated. Downregulation precipitates 'minimising' assessments of the child's needs, with a parenting style characterised as 'distanced protection' with lack of physical and psychological intimacy. Caregiving representations characterised by deactivation are associated with infant avoidant attachment style (Solomon & George, 1996). Insecure anxious parental attachment style is associated with 'cognitive disconnection', which describes the parent's process of mentally separating what they perceive as acceptable (non-threatening) and over-stimulating (threatening) attachment behaviours from their child. Solomon & George (1996) state that cognitive disconnection motivates the parent to keep their child in close proximity and have a bias towards noticing and recalling the positive or 'easy' aspects of interaction and attachment signalling (e.g., the child smiling, initiating cuddles, etc.). These parents can find their child's signalling of distress to be highly aversive, leading to distancing or ineffective attempts to soothe. The relationship is thus experienced as confused and confusing by both parent and child, and is associated with anxious infant attachment style (Solomon & George, 1996).

All three types of organised caregiving systems (secure, avoidant, and anxious) and their associated caregiving representations (flexible integration, deactivation, cognitive disconnection) are considered to be associated with at least 'good enough' parenting, as they provide a degree of consistency for the child (George & Solomon, 2008). In contrast with organised styles of caregiving, disorganised caregiving systems (arising from disorganised parent attachment style) are associated with risky parenting and increased risk of adverse outcomes for the child. George and Solomon (2008) propose that when mothers who have no organised strategy for maintaining equilibrium within their own attachment systems become overwhelmed by their own

distress, the functioning of their caregiving system is compromised via dysregulation or constriction. Dysregulation is characterised by the caregiver feeling helpless and unable to look after themselves or their child, and perceiving their child as defiant, hysterical, and threatening (George & Solomon, 2008). Constriction describes a mental process whereby the mother perceives the child as an extension of herself, rather than an independent entity. This thinking style prevents the mother from assessing the child's needs accurately, and thus from being able to meet those needs appropriately (George & Solomon, 2008). Disorganisation of caregiving representations (dysregulation and constriction) is associated with caregiving behaviours that are experienced as frightening and unpredictable by the child, leading to disorganised infant attachment.

### *Clinical applications*

Caregiving representations have been identified as indicative of MFR quality, itself a predictor of MIR quality and infant attachment (which are in turn predictive of long-term health, wellbeing and developmental outcomes of the infant). Being able to screen for risk of poor MFR quality within the prenatal period could provide health and social care professionals with an opportunity to identify need for, and provide, health promotion and early intervention regarding MFR quality in pregnant women. At present the semi-structured interviews and questionnaires that assess cognitive aspects of MFR quality (e.g., the Working Model of the Child Interview; Benoit, Zeanah, Parker, Nicholson, & Coolbear, 1997) are lengthy and intensive to complete, forming barriers to assessing MFR quality in clinical settings. Brief measures tapping into cognitive aspects of MFR quality (both content and style) could bridge the research-practice gap.

The Prenatal Caregiving Experiences Questionnaire (PCEQ) is a 34 item self-report questionnaire which assesses the process and content of women's caregiving representations in pregnancy. It is currently being assessed for validity and reliability (Brennan, George & Solomon, 2013). The Caregiving Experiences Questionnaire (CEQ) – the postnatal equivalent of the PCEQ – has been shown to have validity and reliability in assessing quality of caregiving representations in the postnatal period (Røhder et al, 2019), and research suggests the PCEQ may also have utility as a screening tool to identify women at risk of poor MFR quality (Røhder, et al., In Press)..

## **Rationale**

The purpose of the current study is to better understand the relationships between psychosocial risk, depression, adult attachment style, mother's affective bond with the fetus, and her caregiving representations. In particular, it aims to identify whether pregnant women's experience of interpersonal psychosocial risk, depression, use of alcohol and substances, their own attachment style, and the nature of their prenatal caregiving representations are predictive of their MFR quality within the second trimester of pregnancy.

## **Research Questions**

The following hypotheses are made:

1. Lower security in maternal adult attachment (greater attachment avoidance and anxiety) will be associated with greater disorganisation of prenatal caregiving representations.
2. Lower security in maternal adult attachment (higher scores on Anxiety and Avoidance subscales of the ECR-RS) will be associated with poorer quality and reduced intensity of maternal-fetal relationship (lower MAAS total score).
3. Greater disorganisation of prenatal caregiving representations (higher scores on Dysregulation and Constriction PCEQ subscales) will be associated with poorer quality and reduced intensity of maternal-fetal relationship (lower MAAS total score).
4. Greater depressive symptomatology (higher score on the EPDS) will be associated with (i) lower maternal attachment security (higher scores on Anxiety and Avoidance subscales of the ECR-RS), (ii) greater disorganisation of caregiving representations (higher scores on Dysregulation and Constriction PCEQ subscales), and (iii) poorer quality and reduced intensity of maternal-fetal relationship (lower MAAS total score).

5. Greater psychosocial risk (higher scores on the ANRQ) will be related to (i) lower maternal attachment security (higher scores on Anxiety and Avoidance subscales of the ECR-RS), (ii) greater disorganisation of caregiving representations (higher scores on Dysregulation and Constriction PCEQ subscales), and (iii) poorer quality and reduced intensity of maternal-fetal relationship (lower MAAS total score).
6. Maternal adult attachment anxiety and avoidance, organisation and security of caregiving representations, depressive symptomatology, and psychosocial risk will be predictive of MFR quality.

## **Method**

### *Participants*

*Inclusion criteria:* to participate in the study, all participants were required to be in the second trimester of pregnancy (13-28 weeks); maternal mood and experience of anxiety has been reported as being the most stable within the second trimester (Lee, Lam, Marie, & Munn, 2007), therefore participation was restricted to the second trimester in an effort to minimise the confounding variables of natural changes in mood and anxiety related to imminent childbirth. Participants were aged 18 years or over, have the intention of carrying their pregnancy to term and to keep their baby within their own care after birth, and have English language literacy skills sufficient for completion of self-report questionnaires. No restriction was placed on whether this was a first pregnancy. *Exclusion criteria:* participants could not have a neurological disorder (historical or current), as potential associated disturbances in cognition, mood, and anxiety were identified as possible confounding variables. Participants were also excluded on the basis of confirmed non-singleton pregnancy, as there is little understanding of how carrying more than one fetus may influence the expression of the maternal-fetal relationship. Current or historical involvement with specialist services for substance misuse issues, or a complex mental health condition or diagnosis (e.g., personality disorder) were also exclusion criteria.

### *Procedure*

The study was advertised via posters and flyers placed in public places where women in the second trimester of pregnancy were likely to see them (e.g., GP and antenatal clinic waiting rooms). In addition, the study was promoted on social media platforms (Twitter, Facebook, and Instagram). Participants accessed and completed the consent form and the questionnaire pack via the study website ([www.thinkingaboutyourbaby.wordpress.com](http://www.thinkingaboutyourbaby.wordpress.com)). The consent form and questionnaires were hosted by Jisc Online Surveys. Participants who completed the online questionnaire pack were eligible to enter a prize draw for £75 worth of vouchers at a national mother and baby care retailer.

### *Ethical approval*

Ethical approval was sought and obtained via the Integrated Research Application System (IRAS) from the West of Scotland Research Committee (WoS REC) on 13 December 2017 (Appendix F, pp.171 – 174) and by University of Edinburgh Health in Social Science Research Ethics. Following favourable ethical consideration by the committee, the study was also approved by the NHS Lanarkshire Research and Development department (see Appendix G, pp.175 – 189 for the most recent study protocol reviewed by the committee).

### *Measures*

*Demographic information.* A bespoke questionnaire captured information regarding participants' age, ethnicity, nationality, country of residence, index of multiple deprivation of their home area, educational status, employment status, and smoking status (see Appendix C, pp.161 – 162).

*Psychosocial risk.* The Antenatal Risk Questionnaire (ANRQ; Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013) is a 12-item questionnaire (responses on a 0 to 5 Likert scale) which can be completed as a self-report. The ANRQ provides a quantitative summary of 'antenatal risk', screening for maternal perinatal mental health problems and suboptimal parenting interactions (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). Items cover significant mental health history, history of abuse and neglect (physical, sexual, and emotional), current level of social support,

anxiety, perfectionism, and stressful life events in the past year (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). The maximum score is 60; 28 is considered the cut-off for 'increased risk'. The ANRQ is reported to be highly acceptable amongst pregnant women and clinicians (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013).

*Alcohol use:* The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente & Grant, 1993) is a 10-item self-report measure (using a 0 to 4 Likert scale). It enables identification of respondents' hazardous or harmful drinking, or alcohol dependence. The AUDIT gathers information regarding frequency of alcohol consumption, number of alcoholic drinks/units of alcohol consumed, dependence and compulsion to drink, drinking-related injury and amnesia, and emotional response and concerns regarding drinking (Babor, Higgins-Biddle, Saunders, Monteiro, 2001). A total score of 8 indicates hazardous and harmful alcohol consumption, and possible dependence (Babor, Higgins-Biddle, Saunders, Monteiro, 2001). The AUDIT is internally consistent across samples and settings; with median Cronbach's alpha across 18 studies of >0.8 (Reinert & Allen, 2002). The AUDIT has good test-retest reliability (correlations across time ranging from 0.8 to 0.9), and construct validity (Reinert & Allen, 2002). It is considered acceptable for use with women, and those with complex mental health issues or significant substance use issues.

*Drug Use:* The Drug Abuse Questionnaire 10 item (DAST-10; Skinner, 1982) is a brief version of the 28 item measure of problematic illicit substance use (Yudko, Lozhkina & Fouts, 2007). The DAST-10 assesses frequency and degree of substance use, respondents' feelings about their substance use, and its' impact on their behaviours and relationships with others. Responses options are 'Yes' (scored 1) and 'No' (scored 0). The DAST-10 has a cut-off score of 3 (Yudko, Lozhkina, & Fouts, 2007). The DAST-10 is a valid measure of substance use, having a 0.97 correlation with the DAST-20, and reporting high correlations with similar measures (Yudko, Lozhkina & Fouts, 2007). The DAST-10 has internal consistency (Cronbach's alpha) between 0.86 and 0.94 (Yudko, Lozhkina & Fouts, 2007), and a test-retest reliability of 0.71 (Yudko, Lozhkina & Fouts, 2007).

*Adult attachment style:* The Experiences in Close Relationships – Relationship Structures questionnaire (ECR-RS; Fraley, Heffernan, Vicary & Brumbaugh, 2011) is a 9 item self-report measure assessing attachment style in close relationships.

Responses are on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). Items 1 to 6 measure avoidant attachment style (items 1, 2, 3, and 4 are reverse-scored), and items 7 to 9 measure anxious attachment. Participants' responses for avoidance and anxiety continua are averaged; there are no cut-off scores. The ECR-RS composite anxiety and avoidance scores are highly reliable, with a Cronbach's alpha of 0.9 (Fraley, Heffernan, Vicary & Brumbaugh, 2011). The ECR-RS has factor structure similar to other measures of adult attachment style, indicating construct validity (Fraley, Heffernan, Vicary & Brumbaugh, 2011). Fraley (2012) has stated that researchers, "...should feel free to modify the items [of the ECR-RS] in any way that seems appropriate to you." Fraley (2012). In this study ECR-RS instructions were adjusted to state "Please answer the following questions regarding important people in your life".

*Depression:* The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987) is a 10-item self-report measure of depression, focused on cognitive symptoms rather than physical (reducing likelihood of false positive answers due to pregnancy-related physical changes). Responses are scored 0, 1, 2, or 3. The maximum score is 30; a score of 12 is commonly used to identify significant depressive symptoms (Cox, Holden, & Sagovsky, 1987). EPDS scores have high specificity (95.7%) and sensitivity (81.1%) in mothers (Murray & Carothers, 1990), and has been validated for antenatal use (Murray & Cox, 1990; Cox & Holden, 2003). The internal consistency of the EPDS has been reported  $>.80$  (Teissedre & Chabrol, 2004).

*Maternal-fetal relationship quality:* The Maternal Antenatal Attachment Scale (MAAS; Condon, 1993) is a 19-item self-report measure which assesses 'quality' and 'intensity' of maternal attachment to the fetus on two respective subscales. 'Quality' relates to mother's affect, and 'intensity' to the amount of time she devotes to thinking about and interacting with her fetus. Answers are scored on anchored Likert scales of 1 to 5, (5 representing high attachment quality and intensity). Some items are reverse-scored. Individual subscale means can be calculated, or the mean of the combined subscales calculated to provide a 'global' score; there is no cut-off score. The MAAS is a reliable and valid measure of the affective aspect of MFR quality, with a Cronbach's alpha score of 0.82 (Condon, 1993).



*Maternal caregiving representations:* The Prenatal Caregiving Experiences Questionnaire (PCEQ; Brennan, George & Solomon, 2013) is a 34-item self-report questionnaire. Agreement with items (statements regarding what it will be like to be a caregiver to their baby) is rated on a 5-point scale. The PCEQ measures five dimensions of defensive processing associated with patterns of caregiving representation: three dimensions of organised caregiving representation (flexible integration, deactivation, and cognitive disconnection) and two dimensions of disorganised caregiving dysregulation (dysregulation and constriction). A mean is obtained for each subscale. The PCEQ is adapted from the validated Caregiving Representations Questionnaire (Røhder et al, 2019). It is the only known quantitative measure of caregiving representations for use in the perinatal period, and has been shown to be predictive of postnatal maternal behaviour (Røhder, et al., In Press).

#### *Planned analyses*

Correlational analysis will be conducted to test the main hypotheses regarding relationships between key variables and MFR quality (MAAS total score). If significant correlations between key variables and MFR quality are identified, forced entry regression analysis will be conducted to identify the predictive value of these variables in terms of variance in MFR quality (MAAS total score). Forced entry regression is considered a suitable method for testing theories in new areas of research (Field, 2013) and is therefore appropriate for analysing data regarding the potential predictive power of caregiving representations on MFR quality.

#### *Power calculation*

Sample size was calculated with G\* Power3 (Faul et al, 2009), using Pajulo, Savonlahti, Sourander, Piha and Helenius (2001) as a model to estimate the effect size for the correlation between maternal caregiving representations, depression, and psychosocial risk. Sample size was estimated using a range of mean effect sizes from  $r = .34$  to  $r = .58$ , with power = .8 and alpha = .05 for one-tailed correlation analyses. Using the lower effect size the required participant sample for the correlation analyses detailed previously is  $n = 52$ .

In order to estimate the sample size for a two-tailed multiple regression with six predictors (attachment anxiety, attachment avoidance, organisation and security of caregiving representations, depressive symptomatology, psychosocial risk), the effect sizes noted above were squared. Assuming a low effect size of  $r = .34$  ( $R^2 = .12$ ), the required number of participants for conducting multiple regression is  $n = 111$ .

## **Analyses**

### *Missing data*

Due to a technical error,  $n = 91$  participants (53% of the  $n = 172$  participant sample) responses omitted five items from three questionnaires: Item 34 of the PCEQ, Item 8 of the EPDS, and Items 4, 5, and 6 of the MAAS). Therefore PCEQ, EPDS, and MAAS total and subscale scores could not be calculated for these  $n = 91$  from the raw data. As the missingness of data was due to a technical error, it was deemed to be missing completely at random (MCAR), i.e., the missingness of data was not related to any other meaningful variables, such as participant age (Garson 2015).

When data is MCAR, it can be deemed acceptable to trim data. However, in situations such as this, where trimming would involve the loss of a large proportion of the overall dataset (and consequently reduce the power of the analyses), statistical estimation of the missing values is considered a legitimate method of managing the problem of data missingness (Osborne, 2013). Multiple imputation using the Markov Chain Monte Carlo (MCMC) was used to estimate the missing data by first creating multiple datasets in which the missing values have been imputed. The estimates from the multiple imputed datasets were pooled, and the pooled data used for the statistical analyses.

### *Multiple Imputation*

In order to conduct correlation and regression analysis on the full data set ( $n = 172$ ), multiple imputation procedures were conducted, to provide theoretically robust estimations of the missing values of each scale item, to then allow calculation of total scale score or subscale score, as recommended by Eekhout et al. (2014). Prior to multiple imputation Little's MCAR test was performed and was not significant (Chi-Square 4204.664), confirming that the data were missing completely at random.

Within SPSS 24 (IBM Corporation, 2016), the selected method of multiple imputation was Fully Conditional Specification, an iterative MCMC method for use on MCAR data. All ordinal and scale variables were entered into the multiple imputation model, as this method is known to produce the most accurate estimates for missing data (Sterne, 2009). The number of imputations was set at 40, in line with Graham et al.'s (2007) recommendation for multiple imputation where 50% of cases are incomplete. All variables, bar those representing scale items which had been missing from distribution, were set as predictor variables only. Scale items which were missing from the initial round of data collection ( $n = 91$ ) but had been included in the second round of data collection ( $n = 81$ ) were set to both predict and receive imputation. The number of iterations was set at 10, the default setting for FCS MCMC analysis (IBM Corporation, 2016), meaning that for each iteration and each variable, the FCS method fits a univariate model using all the other variables within the model as predictors, and then imputes the missing values for the target variable. The process was repeated 10 times, and the imputed values at the maximum iteration are saved to the imputed dataset.

The imputed data were then pooled, using Rubin's rules (Rubin, 2004) to create a final aggregate dataset with the mode of all 40 imputed values for the original missing ordinal data. These imputed values were used in the calculation of PCEQ, EDPS, and MAAS scale and subscale scores. This final aggregate dataset formed the basis for all subsequent correlation and regression analyses. Sensitivity analyses comparing the demographic data and Spearman's correlations were conducted using the incomplete ( $n = 91$ ) and complete ( $n = 81$ ) data sets, to establish whether there were meaningful differences in the data or their findings (see Appendix D, pp. 163 – 169). No significant overall differences were identified, thus the analyses conducted on the multiply imputed dataset are considered acceptable.

### *Assessment of bias within the data*

The distribution of data for questionnaire data total scores and subscale scores were assessed for bias. For the majority of outcome measures, assumptions of normality were violated; tests of skewness and kurtosis were significant in most cases (Table 1). Where data violated assumptions of normality, Spearman's bootstrapped one-tailed non-parametric correlation analyses were conducted to address the primary and secondary hypotheses.

**Table 1: Tests of skewness and kurtosis**

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig
<b>Age</b>	.080	172	.010	.988	172	.167
<b>IMD Quintile</b>	.373	172	.000	.632	172	.000
<b>Flexible Integration</b>	.169	172	.000	.842	172	.000
<b>Deactivation</b>	.145	172	.000	.908	172	.000
<b>Cognitive</b>	.080	172	.009	.989	172	.179
<b>Disconnection</b>						
<b>Dysregulation</b>	.125	172	.000	.893	172	.000
<b>Constriction</b>	.087	172	.003	.976	172	.005
<b>AUDIT Total</b>	.134	172	.000	.908	172	.000
<b>DAST total</b>	.471	172	.000	.518	172	.000
<b>Avoidance</b>	.094	172	.001	.950	172	.000
<b>Anxiety</b>	.182	172	.000	.853	172	.000
<b>Gestation</b>	.105	167	.000	.951	167	.000
<b>Depression</b>	.097	172	.000	.969	172	.001
<b>MAAS total</b>	.064	172	.083	.961	172	.000

## Results

### *Descriptive statistics*

A total of 172 women participated in the study by completing the online questionnaire battery. Patient demographics are summarised in Table 2. The sample was predominantly self-reported White ethnicity, highly educated, and in employment. Participants' mean age was 30.78 years, approximately 50% of the sample were pregnant for the first time, and average gestation was 20.77 weeks. The sample reported a fairly even distribution of IMD values based on postcode of residence, with the majority living in the second-highest quintile bracket.

Descriptive statistics for each of the main outcome measures are reported in Table 3: 20.1% of this community sample experienced increased psychosocial risk (ANRQ score of 28 or above) , 5.8% reported historical sexual abuse, and 5.2% reported historical physical abuse. Four percent of the sample reported hazardous/harmful alcohol use (DAST-10 score of 8 or above). Participants' ECR-RS Anxiety and Avoidance average scores were lower than scale means (2.46 and 2.59 respectively). Mean MFR score (as measured by the MAAS) was 77.7. A quarter of participants' breached clinical cut-off with a score of 12 or greater on the EPDS. The sample reported higher than average levels of Flexible Integration, Cognitive Disconnection, Dysregulation, and Constriction, and lower than average levels of Deactivation in their caregiving representations.

**Table 2: Participants' demographic characteristics (n=172)**

		<b>M</b>	<b>SD</b>	<b>%</b>
<b>Age (yrs)</b>		30.78	4.13	--
<b>Gestation</b>		20.77	4.51	--
<b>Primiparous</b>		--	--	48
<b>IMD quintile</b>	1 <sup>st</sup> quintile (most deprived)	--	--	11.6
<i>(n = 97)</i>	2 <sup>nd</sup> quintile	--	--	8.7
	3 <sup>rd</sup> quintile	--	--	11
	4 <sup>th</sup> quintile	--	--	20.3
	5 <sup>th</sup> quintile	--	--	4.7
<b>Ethnicity</b>	White	--	--	96
<b>Educational attainment</b>	<i>Undergraduate degree (full or partial completion)</i>	--	--	64.5
	<i>Postgraduate degree (full or partial completion)</i>	--	--	6
	<i>College education/mature student learning</i>	--	--	11.6
	<i>Left school aged 17-18 years</i>	--	--	9
	<i>Left school aged 16 years</i>	--	--	9
<b>Employment</b>	<i>Any employment</i>	--	--	93
<i>(n = 171)</i>	<i>Full-time employment</i>	--	--	64
	<i>Part- time employment</i>	--	--	26.7
	<i>Self-employed hour per week not stated)</i>	--	--	2.3
	<i>Unemployed with/without benefits/Volunteering/Student</i>	--	--	2.3

**Table 3: Descriptive statistics regarding main outcome measures**

	<b>M</b>	<b>SD</b>	<b>%</b>
<b>ANRQ (psychosocial risk)</b>			
<b>Total <math>\geq 28</math></b>	--	--	20.1
<i>(increased psychosocial risk)</i>			
<b>Hx sexual abuse</b>	--	--	5.8
<b>Hx physical abuse</b>	--	--	5.2
<b>AUDIT (alcohol use)</b>			
<b>TOTAL <math>&gt; 8</math></b>	--	--	4.0
<i>(hazardous &amp; harmful use)</i>			
<b>DAST-10 (drug use)</b>			
<i>Total = 0 (no concern)</i>	--	--	78.5
<i>Total = 1 – 2 (low incidence of misuse)</i>	--	--	21
<i>Total = 3 (intermediate problematic misuse)</i>	--	--	0.6
<b>ECR-RS (attachment style)</b>			
<i>(subscale mean = 4)</i>			
<b>Anxiety</b>	2.46	1.57	--
<b>Avoidance</b>	2.59	1.08	--
<b>EPDS (depression)</b>			
<b>Total <math>\geq 12</math></b>	--	--	25
<i>(clinically significant)</i>			
<b>MAAS (MFR quality)</b>			
<i>(mean = 57; no cut-off)</i>			
<b>Total</b>	77.7	7.42	--
<b>PCEQ (caregiving representations)</b>			
<i>(all subscale means = 3)</i>			
<b>Flexible Integration</b>	4.67	.34	--
<b>Deactivation</b>	1.68	.52	--
<b>Cognitive Disconnection</b>	3.19	.80	--
<b>Dysregulation</b>	3.79	1.5	--
<b>Constriction</b>	3.72	.66	--

### *Correlations*

Spearman's rho correlations between the main outcome variables are shown in Table 4. Due to the number of correlation analyses conducted, a stringent p value of  $<.01$  was set as the required level of significance in order to reduce the chance of Type 1 error. Correlations reported herein are directly related to the study hypotheses.

### *Attachment style and caregiving representations*

In line with study hypotheses, greater maternal attachment anxiety was significantly correlated with Dysregulation with a medium effect size and greater maternal attachment avoidance was significantly correlated with Dysregulation with a small effect size. However, contrary to hypotheses, greater maternal attachment anxiety was not significantly correlated with Constriction and greater maternal attachment avoidance was not significantly correlated with Constriction.

### *Attachment style, caregiving representations, and MFR QUALITY*

As hypothesised, maternal attachment security (lower maternal attachment anxiety and avoidance) was found to be correlated with better quality of MFR quality with small effect sizes, respectively.

There were mixed findings regarding the relationship between disorganisation of prenatal caregiving representations and MFR quality. Greater Dysregulation of caregiving representations was significantly negatively correlated with MAAS total score, with a medium effect size. However, against expectation, high Constriction score was significantly positively correlated with MAAS total score, with a medium effect size.



### *Depression, attachment style, caregiving representations, and psychosocial risk*

As hypothesised, depressive symptomology was significantly negatively correlated with attachment anxiety (medium effect size) and attachment avoidance (small-to-medium effect size). Depressive symptomology was also significantly positively correlated with greater disorganisation of caregiving representations as measured by higher score on the Dysregulation subscale of the PCEQ (small effect size). Depressive symptomatology was not significantly correlated with Constriction. Contrary to expectation maternal depressive symptoms were not found to be significantly correlated with total MAAS score. Depression was significantly correlated with psychosocial risk.

### *Psychosocial risk, attachment style, caregiving representations, and MFR quality*

Elevated psychosocial risk was significantly positively correlated with attachment anxiety (large effect size), and with maternal attachment avoidance (medium effect size), suggesting that lifetime experience of psychosocial risks such as abuse and mental health difficulties are connected to greater attachment insecurity. Elevated psychosocial risk was significantly positively correlated with higher Dysregulation score (small effect size), implying that maternal psychosocial experience may influence disorganisation of her caregiving system. Elevated psychosocial risk was not significantly correlated with Constriction score; it may be that the enmeshment/role reversal that the Constriction subscale represents in the postnatal period may reflect developmentally appropriate and adaptive caregiving representations during pregnancy. Finally, elevated psychosocial risk was significantly negatively correlated with MAAS total score (small effect size), indicating that maternal psychosocial experiences are related to MFR quality.

**Table 4: Spearman's rho correlation values (95% CI) between main outcome variables**

	Attachment Avoidance	Attachment Anxiety	Flexible Integration	Deactivation	Cognitive Disconnection	Dysregulation	Constriction	MFR quality	Psychosocial risk
<b>Attachment Anxiety</b>	<b>.548**</b> [.42, .66]	--	--	--	--	--	--	--	--
<b>Flexible Integration</b>	<b>-.102</b> [-.25, .04]	<b>-.130*</b> [-.26, .03]	--	--	--	--	--	--	--
<b>Deactivation</b>	<b>.079</b> [-.07, .24]	<b>.270**</b> [.12, .42]	<b>-.260**</b> [-.40, -.13]	--	--	--	--	--	--
<b>Cognitive Disconnection</b>	<b>.070</b> [-.10, .25]	<b>.188**</b> [.03, .34]	<b>.274**</b> [.14, .40]	<b>.003</b> [-.15, .15]	--	--	--	--	--
<b>Dysregulation</b>	<b>.200**</b> [.06, .35]	<b>.427**</b> [.29, .56]	<b>-.380**</b> [-.50, -.24]	<b>.594**</b> [.47, .70]	<b>-.053</b> [-.20, .09]	--	--	--	--
<b>Constriction</b>	<b>-.025</b> [-.18, .13]	<b>-.015</b> [-.16, .14]	<b>.652**</b> [.56, .74]	<b>-.135*</b> [-.29, 0.1]	<b>.414**</b> [.27, .54]	<b>-.294**</b> [-.44, -.15]	--	--	--
<b>MFR quality</b>	<b>-.243**</b> [-.40, -.10]	<b>-.218**</b> [-.35, -.60]	<b>.400**</b> [.27, .52]	<b>-.289**</b> [-.42, -.14]	<b>.309**</b> [.15, .45]	<b>-.457**</b> [-.56, -.33]	<b>.407**</b> [.28, .53]	--	--
<b>Psychosocial risk</b>	<b>.400**</b> [.26, .51]	<b>.515**</b> [.40, .63]	<b>-.170*</b> [-.32, -.01]	<b>.151*</b> [.00, .31]	<b>.190**</b> [.02, .33]	<b>.291**</b> [.15, .44]	<b>-.058</b> [-.20, .08]	<b>-.235**</b> [-.37, -.09]	--
<b>Depression</b>	<b>.293**</b> [.14, .43]	<b>.368**</b> [.23, .50]	<b>-.154*</b> [-.31, -.01]	<b>.187**</b> [.06, .34]	<b>.173*</b> [.03, .31]	<b>.166*</b> [.02, .33]	<b>.110</b> [-.04, .25]	<b>-.042</b> [-.19, .11]	<b>.418**</b> [.29, .55]

(\*p = <.05; \*\*p = <.01)

### *Caregiving representations and MFR quality*

Flexible Integration was significantly positively correlated with MAAS total score (medium effect size), indicating that prenatal caregiving representations characterised by flexible integration were related to better quality maternal antenatal attachment. Deactivation was significantly negatively correlated with MAAS total score (small effect size), indicating that prenatal caregiving representations characterised by deactivation were related to poorer maternal fetal-relationship quality. These two findings support the theory that caregiving representations and MFR are interconnected constructs arising from the caregiving system. Of note, Cognitive Disconnection score was found to significantly positively correlate with MAAS total score (medium effect size). A low score on the Cognitive Disconnection subscale could indicate a tendency to mentally disconnect from the infant. It may be that PCEQ items which intended to reflect Cognitive Disconnection are influenced by the prenatal context, and that high scores on this subscale (reflecting greater cognitive connection or fusion with the fetus) may actually reflect more positive aspects of antenatal attachment, as in this phase of development it is appropriate for the mother to view the fetus as a part of herself.

### *Demographic factors and MFR*

Maternal age was significantly correlated with quality of maternal-fetal relationship (small effect size). However, maternal educational level, employment status, IMD and number of week's gestation were not significantly related to quality of maternal-fetal attachment. Alcohol consumption correlated positively with attachment avoidance, albeit with a small effect size, although this association did not reach the more stringent significance level of  $p = <.01$ . Substance misuse was not found to correlate with any of the main outcome variables.

### Regression

Forced entry regression was selected as the most appropriate method for theory-testing when investigating potential predictors of MFR quality (Field, 2013). Six variables which significantly correlated with MFR quality (MAAS total) were entered simultaneously as predictors: psychosocial risk (ANRQ total), attachment avoidance (ECR-RS), attachment anxiety (ECR-RS), disorganised caregiving representations characterised by dysregulation (PCEQ Dys), secure organised caregiving representations (PCEQ FI), and insecure organised caregiving representations (PCEQ De). Due to the queries raised regarding the conceptual accuracy of the Constriction and Cognitive Disconnection subscales of the PCEQ, they were not included as predictors in the regression model. Table 5 summarises the forced entry regression model. The  $R^2$  value is .258, indicating that 25.8% of variance in MFR quality (MAAS total score) is accounted for by all six predictor variables.

**Table 5: Forced entry regression model summary**

<i>Change Statistics</i>									
R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
.508 <sup>a</sup>	.258	.231	6.508	.258	9.580	6	165	.000	1.675

**Predictors:** psychosocial risk (ANRQ total), attachment avoidance, attachment anxiety, disorganised caregiving representations, secure organised caregiving representations, and insecure organised caregiving representations.

**Dependent variable:** MFR quality (MAAS total).

Table 6 reports the outcome of an analysis of variance (ANOVA), and indicates that the regression model is a significant improvement against a baseline model of MFR quality (MAAS total score).

**Table 6:** ANOVA of forced regression model

	<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>
<b>Regression</b>	2434.073	6	405.679	9.580	.000 <sup>b</sup>
<b>Residual</b>	6987.392	165	42.348		
<b>Total</b>	9421.465	171			

**Dependent variable:** MFR quality (MAAS total).

**Predictors:** psychosocial risk (ANRQ total), attachment avoidance, attachment anxiety, disorganised caregiving representations, secure organised caregiving representations, and insecure organised caregiving representations.

Table 7 reports the standardised beta coefficients for the regression model. Table 7 identifies three statistically significant predictors of variance in MFR quality (MAAS total score). The largest predictor of MFR quality is attachment avoidance, followed by disorganised caregiving representations, and secure organised caregiving representations. All VIF statistics reported in Table 7 are low (below 9), indicating that multicollinearity is not a risk to this model. Assumptions regarding normality of distribution, standardised residual, and independence of errors are met (Table 8).

**Table 7: Forced entry regression coefficients**

	Unstandardized Coefficients		Standardized Coefficients		Collinearity Statistics		
	<i>B</i>	<i>Std. Error</i>	<i>Beta</i>	<i>t</i>	<i>Sig.</i>	<i>Tolerance</i>	<i>VIF</i>
<b>(Constant)</b>	66.850	9.370		7.134	.000		
<b>Psychosocial risk (ANRQ)</b>	-.049	.057	-.070	-.864	.389	.677	1.477
<b>Avoidance</b>	-1.703	.580	-.247	-2.937	.004	.636	1.571
<b>Anxiety</b>	.333	.429	.071	.775	.440	.542	1.844
<b>Secure Organised Caregiving Representations (PCEQ FI)</b>	4.590	1.721	.212	2.667	.008	.710	1.409
<b>Insecure Organised Caregiving Representations (PCEQ De)</b>	-.187	1.301	-.013	-.144	.886	.536	1.867
<b>Disorganised Caregiving Representations (PCEQ Dys)</b>	-3.677	1.602	-.236	-2.295	.023	.425	2.351

**Dependent variable:** MFR quality (MAAS total).

**Table 8: Residuals statistics**

	<b>Min.</b>	<b>Max.</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>Predicted value</b>	62.05	83.75	77.71	3.773	172
<b>Residual</b>	-24.627	18.950	.000	6.392	172
<b>Std. predicted value</b>	-4.151	1.602	.000	1.000	172
<b>Std. residual</b>	-3.784	2.912	.000	.982	172

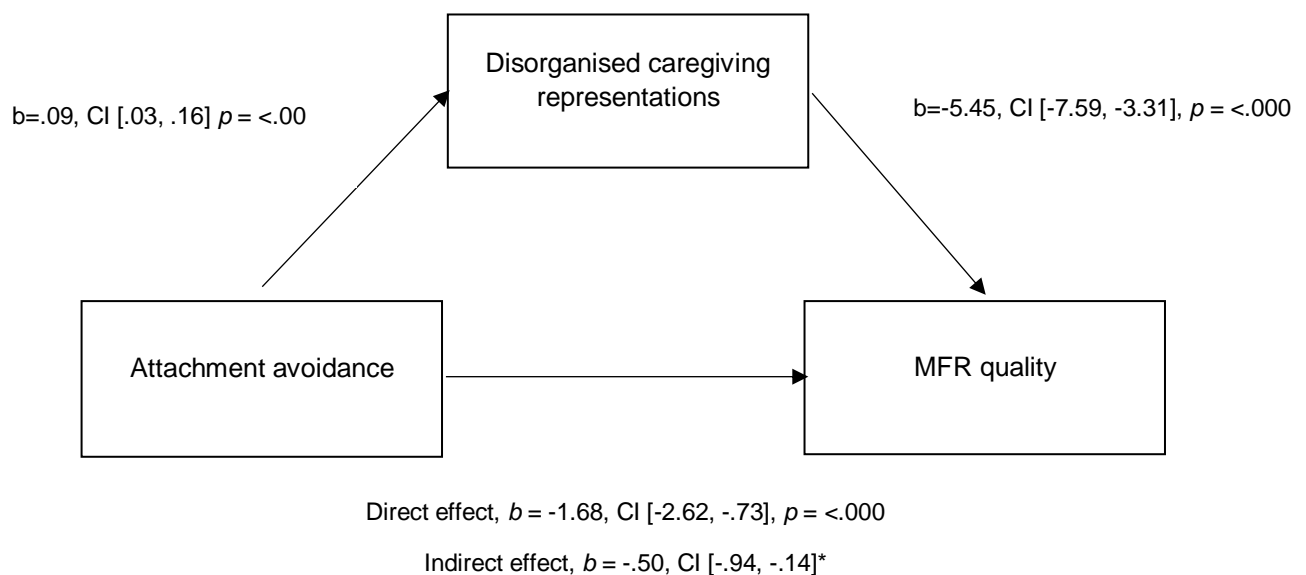
**Dependent variable:** MFR quality (MAAS total).

### Mediation modelling

In order to better understand the relationships identified by the regression model, exploratory mediation analyses were conducted regarding the relationships between attachment avoidance, MFR quality, and caregiving representations. Due to the post hoc nature of this analysis, bootstrapping was employed to reduce risk of bias.

Figure 1 shows that disorganised caregiving representations partially mediate the relationship between attachment avoidance and MFR quality, as the indirect effect of attachment avoidance on MFR quality is less than the direct effect when disorganised caregiving representations are added to the model. Specifically, attachment avoidance is significantly predictive of disorganised caregiving representations – as attachment avoidance increases, degree of disorganisation of caregiving representations increases (and vice versa). Figure 2 also shows that, as disorganisation of caregiving representations increases, MFR quality decreases. See Table 9, Table 10, and Table 11 (Appendix E, p.169) for the mediation model summary statistics.

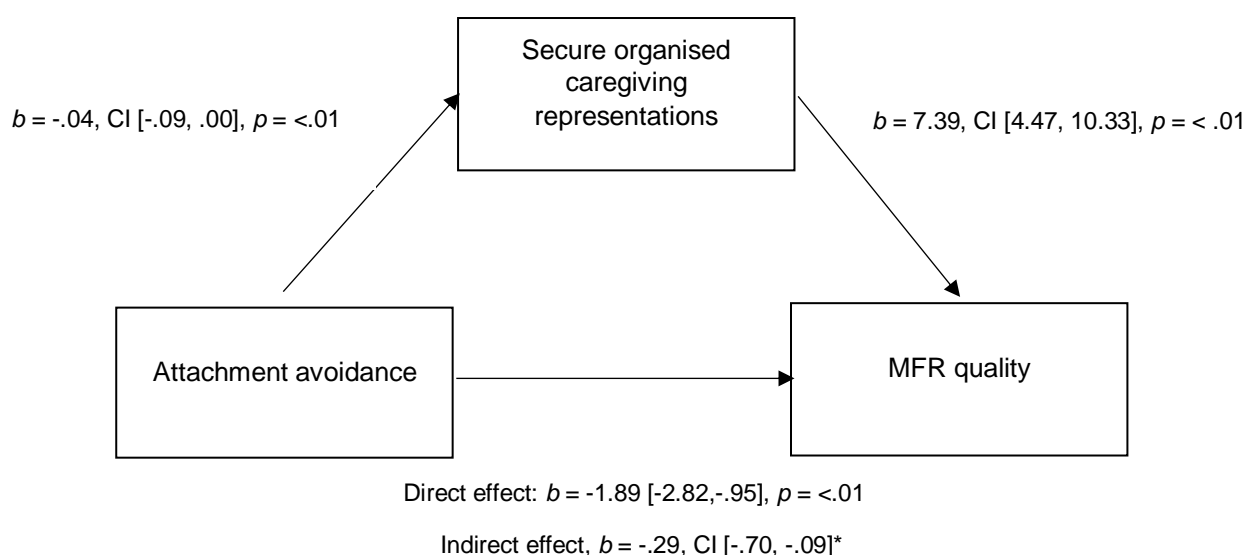
**Figure 1: Mediation model of attachment avoidance as a predictor of MFR quality, mediated by disorganised caregiving representations**



\*BCa bootstrapped CI based on 5000 samples.

Figure 2 shows that secure organised caregiving representations partially mediate the relationship between attachment avoidance and MFR quality, as the indirect effect of attachment avoidance on MFR quality is less than the direct effect when secure organised caregiving representations are added to the model. Specifically, attachment avoidance is significantly predictive of secure organised caregiving representations – as attachment avoidance increases, degree of security and organisation of caregiving representations decreases (and vice versa). Figure 1 also shows that, as security and organisation of caregiving representations increases, so does MFR quality. See Table 12, Table 13, and Table 14 (Appendix E, p.170) for the mediation model summary statistics.

**Figure 2: Mediation model of attachment avoidance as a predictor of MFR quality, mediated by secure organised caregiving representations**



\*BCa bootstrapped CI based on 5000 samples.



## Discussion

The current study aimed to better understand the relationship between maternal attachment style, the maternal caregiving system, and the quality of the maternal-fetal relationship in the second trimester of pregnancy in the general population.

The hypothesis that reduced adult attachment security would be related to greater disorganisation of caregiving representations was partially supported, with significant negative correlations reported between both attachment avoidance and anxiety, and dysregulated caregiving representations (medium and small effect sizes, respectively). These findings may support the theory that activation of an insecure maternal attachment system is related to disorganisation and disrupted function of the maternal caregiving (George & Solomon, 2008).

Contrary to hypothesis, the relationships between maternal attachment avoidance/anxiety and constricted caregiving representations were non-significant. These apparently opposing findings regarding the relationship between maternal attachment insecurity and types of disorganised caregiving representations may be due to qualitative differences between the Dysregulation and Constriction subscales of the PCEQ. The Dysregulation subscale is intended to reflect conflict and negative emotion in anticipation of postnatal relationships, and comprises items such as “Sometimes being a parent will seem like a battle and if my baby won’t cooperate, one of us must give in” (Item 9) and “Life will be chaotic and my baby will make me feel out of control” (Item 21). The Constriction subscale is intended to reflect maternal enmeshment with the baby, reflective of a propensity to inappropriate reverse the caregiving relationship in the postnatal period (George & Solomon, 2008). However, items which may effectively tap this construct in the postnatal period such as “My baby is a real part of me. I can’t imagine what it would be like to live without him or her” (Item 25), and “My baby and I will be so close that we will almost be able to tell each other’s feelings. We will be really tuned into each other” (Item 40), may in fact reflect positive MFR quality in the *prenatal* period, when arguably feeling ‘at one’ with the fetus is a developmentally appropriate state of mind. Further exploration of how constricted parental caregiving representations may manifest in the prenatal period is required.

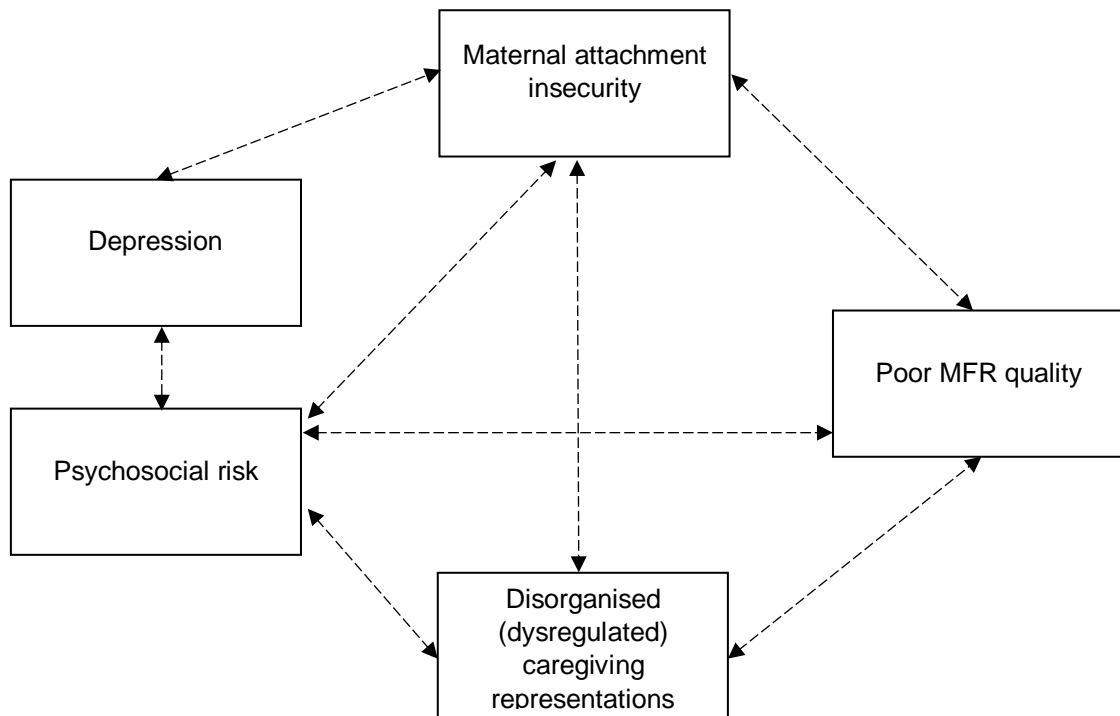
As hypothesised, and consistent with existing literature, depressive symptomology was significantly negatively correlated with attachment avoidance and anxiety (Malik, Wells, & Wittkowski, 2015), dysregulation of caregiving representations (Vreeswijk,

Maas, Van Bakel, 2012), and psychosocial risk (Lancaster et al., 2010). Unexpectedly, depressive symptomatology was not significantly correlated with constricted caregiving representations or with MFR quality. This may be related to the query raised regarding the validity of the Constriction subscale as a measure of disorganised caregiving representations in the perinatal period, or be reflective of the previously identified differential relationship between depression and quality of caregiving representations. Sokolowski, Hans, Bernstein, and Cox (2007) found no relationship between representation distortion and maternal depression using the Working Model of the Child Interview, but did find that maternal hostility was related to caregiving representation distortion. Therefore the context in which maternal depression occurs may be more relevant to caregiving representation quality than the symptomatology of depression per se (Sokolowski, Hans, Bernstein, & Cox, 2007).

Hypotheses regarding the relationships between greater psychosocial risk and lower maternal attachment security, greater dysregulation of caregiving representations, and poorer MFR quality were supported. These findings echo those of previous research (Hatzis, Dawe, Harnett, & Barlow, 2017, 2017; Katznelson, 2014; Maas et al., 2014; Murphy et al., 2014; Røhder et al., 2019; Yarcheski, Mahon, Yarcheski, Hanks, & Cannella, 2009). The hypothesised relationship between greater psychosocial risk and greater constriction of caregiving representations was not supported.

Figure 3 is a diagram (framework) conceptualising the relationships between key factors that have been identified in this study's data; the bidirectional arrows indicate the significant ( $p < .01$ ) correlations between key variables identified in this study. This framework implies that psychosocial risk factors are important when considering a woman's vulnerability to poor MFR quality.

**Figure 3: Framework depicting the significant ( $p = <.01$ ) correlations between key variables in this study.**



It is striking that associations between psychosocial risk factors and MFR quality are evident (Figure 3) even within a community sample skewed towards higher SES, reflecting as it did a lack of ethnic diversity (96% White), high educational attainment (70% with undergraduate degree or higher), and high level of employment (93% in in full- or part-time employment). However, 20% of respondents reported an ANRQ score of  $\geq 28$  (indicative of increased psychosocial risk), and 5.8% and 5.2% reported a lifetime experience of sexual and physical abuse respectively. In addition, 25% of the study sample reported clinical levels of depressive symptoms on the EPDS, and 7% reported a significant degree of alcohol use (associated with attachment avoidance). These data suggest that experience of mental health difficulties and abuse are relatively common in the general population, a finding supported by the Welsh Adverse Childhood Experiences study (Bellis et al., 2015). However, due to the study inclusion criteria, it is assumed that participants did not consider themselves to have significant mental health or substance misuse difficulties, and were not in receipt of additional support in the perinatal period. This suggests that a significant

number of expectant mothers who may benefit from additional support during pregnancy are not currently identified by health and social care services (Bauer, Parsonage, Knapp, Lemmi & Adelaja, 2014). Disorganisation of caregiving representations and poor quality MFR are likely to be even more pronounced in populations who experience substantial and chronic psychosocial adversity, such as women with a significant history of ACEs (Bellis et al., 2015); women with SM difficulties, experience of domestic abuse, and/or have severe and enduring mental health problems (Bauer, Parsonage, Knapp, Lemmi & Adelaja, 2014), are detained within the criminal justice system (Sharp, Peck & Hartsfield, 2012), and who are homeless (Phipps, Dalton, Maxwell, & Cleary 2019). It is important to note that all of these categories of psychosocial adversity substantially overlap (Aitkinson, et al., 2000; Wu, Schairer & Dellor 2010).

Forced entry regression modelling tested the hypothesis that maternal attachment style, organisation and security of caregiving representations, and degrees of psychosocial risk would be predictive of MFR quality. Regression analysis revealed that maternal attachment avoidance was the largest significant predictor of MFR quality, with a standardised  $\beta = -.247$ , meaning that for every standard deviation increase in attachment avoidance, MFR quality fell by  $-.247$  standard deviations. Disorganisation (dysregulation) of caregiving representations (standardised  $\beta = .236$ ) was also identified as a significant negative predictor of MFR quality. The practical application of these findings is that expression of maternal attachment avoidance and disorganised caregiving representations may be useful as assessment indices to help health and social care professionals screen for risk of suboptimal MFR quality. Use of a self-report measure such as the PCEQ would be a practical tool for screening purposes, in comparison to existing interview methods of assessing MFR quality (Benoit, Zeanah, Parker, Nicholson & Coolbear, 1997). Whilst assessing MFR quality is not currently common practice in prenatal care, it could in future be incorporated into assessment protocols, as early identification of potential risks would allow health promotion and early intervention activities to be engaged upon. In cases where women with pre-existing vulnerability to poor MFR/MIR are known to health and social care service (for example in women who have already had infants/children removed from their care or have children who have been placed on the child protection register) dysregulation of caregiving representations may be a useful index to use to assess the efficacy of intervention work.

Secure organisation of caregiving representations (standardised  $\beta = .212$ ) was also identified by regression modelling as a significant predictor of MFR quality; this finding suggests that investing in interventions which support development of secure organised caregiving representations in expectant mothers may be an effective method by which MFR quality (and consequently MIR quality) may be optimised.

Exploratory post hoc mediation analyses confirmed that caregiving representations (both disorganised dysregulated and secure organised types) partially mediate the relationship between maternal avoidant attachment style and MFR quality. These findings indicate that tailored cognitive therapy to increase organisation of caregiving representations may be an appropriate means of intervention to improve MFR quality.

Although regression modelling did not identify wider psychosocial risk factors as significant predictors of MFR quality, the significant correlations between such factors as identified in this research and the wider literature should not be ignored. While further research which unpicks the precise influence of these factors on maternal caregiving representations in pregnancy is required, it seems likely that an ecological systems approach is likely to be most effective when endeavouring to support women develop good quality MFR (Fortson, Klevens, Merrick, Gilbert, & Alexander, 2016; Hatzis, Dawe, Harnett, & Barlow, 2017).

#### *Limitations and directions for research*

A key limitation of this review is the cross-sectional nature of the data. Longitudinal work is required to verify whether these findings are replicable and predictive of postnatal mother-infant relationship and infant attachment. This study collected data from the second trimester because it is the time where maternal mood and anxiety is most stable; the third trimester is associated with greater maternal anxiety which could have been a confounding variable (Lee, Lam, Marie, & Mun, 2007). However, there is evidence to suggest that MFR quality may undergo a shift in the third trimester, as the mother prepares for birth and the reality of her baby as an individual becomes more salient (Yarcheski, Mahon, Yarcheski, Hanks, & Cannella, 2009). Therefore, further research is merited to understand this phenomenon and its link with MIR quality will be of benefit when considering the role of MFR quality screening in health settings.

The fact that the PCEQ has not yet been psychometrically validated measure of prenatal caregiving representations is a drawback to this study. Efforts to validate this study will be of great importance to this area of research. The scope of this study was narrow, focusing solely on the MFR. As social support for mothers' is known to be an important covariate to MFR quality, and particularly partners' presence and supportiveness is known to moderate the MFR quality (Alhusen et al., 2012; Perry, Ettinger, Mendelson, & Le, 2011), it will be important for future work to include these important factors. It may also be of interest to collect data regarding changes to MFR quality over the course of pregnancy. The complexity of the emotional and cognitive experience women experience cannot be entirely captured by the use of questionnaire measures; future research is therefore likely to benefit from a mixed methods approach.

## **Conclusion**

This study is the first of its kind to examine the relationships between a range of psychosocial variables on MFR quality and caregiving representations. Findings have identified that disorganised and secure organised maternal caregiving representations in the second trimester of pregnancy are significant predictors of MFR quality. In addition, prenatal caregiving representations were found to mediate the relationship between avoidant attachment style and MFR quality. Prenatal caregiving representations may therefore be useful as an index of MFR quality which could be routinely screened at antenatal health care appointments to allow for early identification of women who may need extra support to develop a positive relationship with their baby. Environmental and interpersonal stressors are recognised as key variables which may influence mothers' wellbeing and MFR quality.

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## **Appendix A: Infant Mental Health Journal author guidelines**

The *Infant Mental Health Journal* (IMHJ) is the official publication of the World Association for Infant Mental Health (WAIMH) and is copyrighted by the Michigan Association for Infant Mental Health.

### **Information for Contributors**

Reflecting the interdisciplinary nature of the field, its international focus, and its commitment to clinical science, the IMHJ publishes research articles, literature reviews, program descriptions/evaluations, clinical studies, and book reviews on infant social–emotional development, caregiver–infant interactions, and contextual and cultural influences on infant and family development. The Journal is organized into three sections: Research, Clinical Perspectives, and Book Reviews. Research focuses on empirical research. Clinical Perspectives allows for more diversity in types of submissions and is designed to advance infant mental health practice and scholarship. Requests for book reviews should be sent by the author or publisher to the Editor In Chief. Please do not send a copy of the book until the request is approved.

The Journal welcomes a broad perspective and scope of inquiry in infant mental health and has an interdisciplinary and international group of associate editors, consulting editors, and reviewers who participate in the peer review process. In addition to regular submissions to the Journal, proposals for special issues or sections are also welcome. These should be discussed with the Editor In Chief prior to submission.

MANUSCRIPTS for submission to the *Infant Mental Health Journal* should be forwarded to the Editor as follows:

1. Go to your Internet browser (e.g., Netscape, Internet Explorer).
2. Go to the URL <http://mc.manuscriptcentral.com/imhj>
3. Register (if you have not done so already).
4. Go to the Author Center and follow the instructions to submit your paper.
5. Please upload the following as separate documents: the title page (with identifying information) and all remaining files without any identifying information, including the body of your manuscript, and each table and figure. Please note that the cover letter is uploaded directly into a field in the on-line submission platform.
6. The Title Page should include a discussion of any conflicts of interest, human subjects approvals, and funding. Acknowledgements may also appear here. The Infant Mental Health Journal complies with all relevant recommendations from the International Committee of Medical Journal Editors in these areas.
7. Your abstract should be uploaded into the appropriate field at the submission website and should also be included in the main text of the manuscript. The abstract in the manuscript must include 3-5 key words listed at the end of the text.

8. Please note that this journal's workflow is double-blinded. Authors must prepare and submit files for the body of the manuscript and any accompanying files that are anonymous for review (containing no name or institutional information that may reveal author identity).
9. All related files will be concatenated automatically into a single .PDF file by the system during upload. This is the file that will be used for review. Please scan your files for viruses before you send them, and keep a copy of what you send in a safe place in case any of the files need to be replaced.
10. Style must conform to that described by the American Psychological Association *Publication Manual*, Sixth Edition, 2009 (American Psychological Association, 750 First Street, N.E., Washington, D.C. 20002-4242). Authors are responsible for final preparation of manuscripts to conform to the APA style.

Manuscripts generally do not exceed 10,000 words and will be assigned for peer review by the Editor or Associate Editor(s) and reviewed by members of the Editorial Board and invited reviewers with special knowledge of the topic addressed in the manuscript. The Editor retains the right to reject articles that do not meet conventional clinical or scientific ethical standards. Normally, the review process is completed in 3 months. Nearly all manuscripts accepted for publication require some degree of revision. There is no charge for publication of papers in the *Infant Mental Health Journal*. The publisher may levy additional charges for changes in proofs other than correction of printer's errors. Authors have the option to participate in Wiley's OnlineOpen program which allows authors of primary research articles to make their article available to non-subscribers on publication and archive the final version of their article. With OnlineOpen, the author, the author's funding agency, or the author's institution pays a fee to ensure that the article is made available to non-subscribers upon publication via Wiley Online Library, as well as deposited in the funding agency's preferred archive. For more information, please visit the [OnlineOpen page](#).

Proofs will be sent to the corresponding author and must be read carefully because final responsibility for accuracy rests with the author(s). Author(s) must return corrected proofs to the publisher in a timely manner. If the publisher does not receive corrected proofs from the author(s), publication will still proceed as scheduled.

Author guidelines were accessed at:

<https://onlinelibrary.wiley.com/page/journal/10970355/homepage/forauthors.html> on 3rd February 2019.

## Appendix B: Systematic review materials

### Bespoke risk of bias assessment tool pro forma

**Adapted from:** Williams JW, Plassman BL, Burke J, Holsinger T, Benjamin S (2010). Preventing Alzheimer's Disease and Cognitive Decline. Evidence Report/Technology Assessment No. 193. (Prepared by the Duke evidence-based practice center under contract No. HHS-290-2007-10066-I). Agency for Healthcare Research and Quality: Rockville, MD.

**Study Name:**

**1<sup>st</sup> reviewer name:**

**Date:**

**2<sup>nd</sup> reviewer name:**

**Date:**

Item	Question	Decision Yes = 2; Partially = 1; Can't Tell = 0; No = 0; N/A	Notes
1	Is the selection of the participant sample unbiased?		
2	<i>Does selection minimize baseline differences between samples? (For controlled studies only)</i>		
3	<i>Is sample size calculated? (For controlled studies and where studies test for predictors/correlates of maternal-fetal/infant relationship quality)</i>		
4	Is description of the cohort adequate?		
5	Is a systematic/validated method for assessing maternal-fetal/infant relationship quality used?		
6	Is a systematic/validated method for assessing substance use used?		
7	Was outcome assessment conducted blind?		
8	<i>Was there an adequate follow-up period? (Longitudinal studies only)</i>		
9	Was missing data/drop-out adequately recorded/managed?		
10	<i>Does analysis control for confounds? (In controlled studies and where studies test for predictors/correlates of maternal-infant relationship quality)</i>		
11	Are the analytic methods used appropriate?		

## Bespoke risk of bias assessment guidance

**Adapted from:** Williams JW, Plassman BL, Burke J, Holsinger T, Benjamin S (2010). Preventing Alzheimer's Disease and Cognitive Decline. Evidence Report/Technology Assessment No. 193. (Prepared by the Duke evidence-based practice center under contract No. HHS 290-2007-10066-I). Agency for Healthcare Research and Quality: Rockville, MD.

**General instructions:** Grade each criterion as “Yes,” “No,” “Partially,” or “Can’t tell.” Where item is not applicable write: **N/A**.

Factors to consider when making an assessment are listed under each criterion. Note that some criteria will only apply to specific types of study.

**Note:** Where a criterion only applies to a specific design, it is in italics.

### Definitions

**Perinatal period:** pregnancy and up to one year post-partum.

**Mother–infant relationship:** Operationalisation of terminology is broad, and can refer to particular aspects of maternal-infant relationship, such as mother's cognitive perception of the child or feelings toward the child, specific parenting behaviours, or widely recognised constructs such as child's attachment style. Studies provide a clear definition of maternal-child attachment/bond/relationship quality, including operationalisation or associated behaviours (e.g., specific aspects of caregiving).

**Substance use:** Use of licit drugs (alcohol, tobacco, prescription medication) use with greater frequency and/or in greater quantities than recommended; use of any illicit drug;

### 11. Is the selection of the participant sample unbiased?

Factors that help reduce selection bias:

- Inclusion/exclusion criteria
  - Clearly described
- Recruitment strategy
  - Clearly described
- Typical or clinical population
  - Clearly detailed
  - Sample is representative of the population of interest: mother-fetus/infant dyads in the perinatal period (mothers use or are in treatment for use of substances).

### 2. Does selection minimize baseline differences between samples? (For controlled studies only)

Factors to consider:

- Was selection of the comparison group appropriate? Consider whether comparable participant samples are likely to differ on factors related to the outcome. Matching on key demographics (e.g., gender and population sample type) would be required to minimize bias.
- Did the study investigators do other things to ensure that comparable groups were similar, e.g., by using stratification or matching techniques?



**3. Is sample size calculated? (For controlled studies and where studies test for predictors/correlates of maternal-fetal/infant relationship quality)**

Factors to consider:

- Did the authors report conducting a power analysis or describe some other basis for determining the adequacy of study group sizes for the primary outcome(s) of interest to us?
- Did the eventual sample size deviate by  $\leq 10\%$  of the sample size suggested by the power calculation?

**4. Is description of the cohort adequate?**

- Consider whether the cohort is well-characterized in terms of baseline demographics?
- Consider key demographic information such as age, gender and country of origin.
- Information regarding education or socio-economic characteristics is also important.

**5. Is a systematic/validated method for assessing maternal-fetal/infant relationship quality used?**

Factors to consider:

- Was the method used to assess maternal-infant relationship quality clearly described? (Details should be sufficient to permit replication in new studies)
- Was a valid and reliable measure or a systematic process, used to assess maternal-fetal/infant relationship quality?

**11. Is a systematic/validated method for assessing substance use used?**

Factors to consider:

- Were substance use outcomes assessed using valid and reliable measures or a systematic methodology? Note that measures that consist of single items of scales taken from larger measures are likely to lack content validity and reliability.
- Were these measures implemented consistently across all study participants?

**9421. Was outcome assessment conducted blind? (For experimental or comparison studies)**

- In studies using experimental designs or comparing cohort outcomes, were investigators blind to sample group when assessing outcome data?

**8. Was there an adequate follow-up period? (Longitudinal studies only)**

Factors to consider:

- A justification of the follow-up period length is preferable.
- Follow-up period should be the same for all groups
- If differences in follow-up time were present, was this difference adjusted for using statistical techniques?

## **9. Was missing data/drop-out adequately recorded/managed?**

Factors to consider:

- Did missing data from any group exceed 20%?
- In longitudinal studies consider attrition over time as a form of missing data. Note that the criteria of < 20% missing data may be unrealistic over longer follow-up periods.
- If missing data is present and substantial, were steps taken to minimize bias (e.g., sensitivity analysis or imputation)?

### **9421. *Does analysis control for confounds? (In controlled studies and where studies test for predictors/correlates of maternal-infant relationship quality)***

Factors to consider for controlled studies:

Does the study identify and control for important confounding variables and effect modifiers?  
These may include demographic and clinical variables.

### **9421. *Are the analytic methods used appropriate?***

Factors to consider:

- Was the kind of analysis done appropriate for the kind of outcome data (categorical, continuous, etc.)?
- Was the number of variables used in the analysis appropriate for the sample size? (The statistical techniques used must be appropriate to the data and take into account issues such as controlling for small sample size, clustering, rare outcomes, multiple comparison, and number of covariates for a given sample size)

**Table 4: Summary of measures of cognitive, emotional, and relational/behavioural dimensions of MFR/MIR**

<b>Maternal-fetal relationship measures</b>	
<b>Cognitive dimensions</b>	
<i>Beliefs and knowledge of infant development &amp; knowledge of health and safety practices</i>	Knowledge of Infant Development Inventory (KIDI; Goldman-Fraser, 1997)
<i>Maternal self-efficacy/expectations of parenting competence</i>	MSEQ (Goldman-Fraser, 1997)
<i>Perception of infant behaviour</i>	PIBS (Goldman-Fraser, 1997)
<b>Emotional &amp; relational/behavioural dimensions</b>	
<i>Differentiation of self from fetus, interaction with fetus, attributing characteristics and intentions to the fetus, giving of self, and role-taking</i>	Maternal-Fetal Attachment Scale (MFAS; Magee et al., 2014; Mikhail, Youchah, DeVore, Ho, & Anyaegbunam, 1995; Shieh & Kravitz, 2006)
<i>Perception of and relationship with fetus, maternal changes in thoughts and feelings mother experiences in relation to herself and her partner</i>	Pregnancy Interview (PI; Pajulo et al., 2012)
<b>Maternal-infant relationship measures</b>	
<b>Emotional &amp; relational/behavioural dimensions</b>	
<i>Infant attachment style</i>	Attachment Q-Set (AQS; McCullough, 1999)
<i>Quality of mother-infant interaction</i>	Bespoke measure (Johnson & Rosen, 1990)
	Care Index of Infants and Toddlers (CI; Pajulo, 2012)
	Coding Interactive Behavior protocol (CIB; Nash, 2013)
	Emotional Availability Scales (EAS; Belt et al., 2012; Goldman-Fraser, 1997)
	Infant and Caregiver Engagement Phases (ICEP; – Nash, 2013)
	Maternal Behavior Q-Set (MBQ; McCullough, 1999)
	Mother-Child Rating Scales (MCRS; O'Connor, Signman, & Kasari 1992)
	National Institute of Child Health and Human Development network procedure (NICHD procedure; Sarfi, Smith, Waal, & Sundet, 2011)
	Nursing Child Assessment Feeding Scale (NCAFS – Blackwell, Kirkhart, Schmitt, & Kaiser, 1998)
	Nursing Child Assessment Teaching Scale (NCAT; Hogan, 2002; Huebner, 2002)
	Objective Rating of Infant Behavior Scale (ORIB; Goldman-Fraser, 1997)
	Parent Caregiving Involvement Scale (P/CIS; McCullough, 1999)
	Parental Development Interview Revised (PDI-R; Pajulo et al., 2012).
<i>Environmental factors associated with positive child development</i>	Home Observation for Measurement of the Environment Inventory (HOME; Huebner, 2002; Kelly, 2002)

## **Maternal-fetal relationship quality outcome measures**

*Knowledge of Infant Development Inventory (KIDI):* Goldman-Fraser (1997) used a modified version of the KIDI (MacPhee, 1981) to assess mothers' beliefs about infant development and developmental principles, and knowledge of infant health and safety practices. In its complete form the KIDI is a 58-item questionnaire which assesses parents' knowledge about child-rearing practices, developmental processes, and infant normative milestones. The internal reliability of the KIDI when completed by parents is reported as .82; two week test-retest reliability as .91 (MacPhee, 1981).

*Maternal-Fetal Attachment Scale:* Magee et al. (2014), Mikhail, Youchah, DeVore, Ho, and Anyaegbunam (1995), and Shieh and Kravitz (2006) used the Maternal-Fetal Attachment Scale (MFAS; Cranley, 1981), which is a 24-item self-report scale on which each item is answered using a 5-point Likert scale. The MFAS assesses five dimensions of MFR – differentiation of self from fetus, interaction with the fetus, attributing characteristics and intentions to the fetus, giving of self, and role-taking (Van den Bergh & Simons (2009). The reliability of the MFAS has been assessed in a number of different studies, with the Cronbach alphas ranging from .76 and .92 for the total scale.

*Maternal-Self Efficacy Questionnaire:* Goldman-Fraser (1997) used the Maternal Self Efficacy Questionnaire (MSEQ; Teti & Gelfand, 1991) was to capture mothers' expectations of their own parenting competence in the prenatal and postnatal periods, with specific reference to mothers' feelings of efficacy in tasks of caring for the infant. Internal consistency of the scale has been reported as .79 and .86 on two samples, and its concurrent validity as  $r=.75$ ,  $P<.001$ ) when compared with the Parenting Stress Index Sense of Competence subscale (Teti & Gelfand, 1991).

*Perceptions of Infant Behavior Scale:* Goldman-Fraser (1997) used the Perceptions of Infant Behavior Scale (PIBS; Nover, Shore, Timberlake, & Greenspan, 1984) to assess mothers' prenatal expectations of infant behaviour, and postnatal perceptions of infant behaviour. Content validity was said to have been established by a panel of experts in the original study, and inter-rater reliability was reported to be high after training (Nover, Shore, Timberlake, & Greenspan, 1984).

*Pregnancy Interview:* Pajulo et al. (2012) used the Pregnancy Interview (PI). The PI is a semi-structured interview comprising 24 items designed to illicit the mother's perception of her unborn baby and her relationship with it and the thoughts feelings,

and changes she experiences in relation to herself and her partner (Slade, 2002). The Pregnancy Interview has been reportedly used in a number of samples and been found to be predictive of adult attachment classification (Sadler et al., 2013), however direct data regarding reliability and validity of the PI has not been accessible to the authors of this review.

## **Maternal-infant relationship quality outcome measures**

*Attachment Q-Set (AQS):* McCullough (1999) used the AQS (Waters & Deane, 1985) to score infant attachment behaviours demonstrated during an observed maternal-infant interaction. Meta-analysis has confirmed the convergent validity of the AQS with Strange Situation procedure security ratings ( $r=.39$ ), and predictive validity with sensitivity measures ( $r=.39$ ; Van Ijzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004). The reliability of the AQS has been reported as  $r=.28$  on a combined sample of four cohorts ( $n=162$ ). The observer AQS is considered to a valid and reliable measure of attachment style (Van Ijzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004).

*Bespoke measure based on Thomas and Chess' (1977) dimensions of infant temperament :* Johnson and Rosen (1990) used Thomas and Chess' (1977) dimensions of infant temperament to rate videotaped mother-infant interactions; this method is unstandardized and no validity/reliability data can be reported.

*Care Index of Infants and Toddlers:* Pajulo et al. (2012) used the Care Index of Infants and Toddlers (CI; Crittenden, 2003). Content validity has been reported as high, with the CI correlating significantly with a large effect size with measure of child attachment security ( $r=.523$ ,  $p<.000$ ; Künster, Fegert, & Ziegenhain, 2010). Test-retest reliability has been reported as ( $r = .398$ ,  $p = .040$ ; Künster, Fegert, & Ziegenhain, 2010). ).

*Coding Interactive Behaviour protocol:* Nash (2013) used the Coding Interactive Behavior (CIB) protocol (Feldman, 1998). The CIB provides a framework by which parent-infant interactions are coded based on a set of observable behaviours. 43 behaviour scales are coded by trained observers using a 5 point Likert, and can be used to assess parent-infant interactions where children are two months to three years of age. Internal consistency of the CIB has been reported as .75, and reliability as  $r=.91$  (Dollberg, Feldman, Keren & Guedeney, 2006).

*Emotional Availability Scales:* Belt et al. (2012) and Goldman-Fraser (1997) used the Emotional Availability Scales (EAS, Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014), which is a rating scale used to assess the quality of dyadic interaction within parent-child (and other adult-child) relationships. Subscales of the EAS are used to assess specific qualities of the quality of interaction for both parent and child. The dimensions of emotional availability within the dyad are named as adult sensitivity, structuring, non-intrusiveness, non-hostility, and child

responsiveness and involvement of the adult Biringen, Derscheid, Vliegen, Closson, and Easterbrooks (2014). Reliability of the EAS has been reported to be good, for example Bornstein et al. (2006) reported intra-class correlations of .79 for the dimensions of non-hostility and .92 for sensitivity. EAS has been shown to have construct validity when examined in reference to infant attachment style (Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014).

*Home Observation for Measurement of the Environment (HOME) Inventory:* Huebner (2002) and Kelly (2002) used the HOME Inventory (Caldwell & Bradley, 1978). The HOME Inventory is completed by conducting observation of infant and caregiver within their home environment, and completion of a semi-structured interview with the caregiver. It measures environmental factors associated with positive child development – emotional and verbal responsiveness of the caregiver, avoidance of restriction and punishment, organization of the environment, provision of appropriate play materials, maternal involvement with the child, and opportunities for variety in daily stimulation. The HOME Inventory is scored on 45 binary choice items (Huebner, 2002). Kelly (2002) reported inter-rater reliability as 89.6%, test-retest reliability as  $r=.62$ , and internal consistency as  $r=.89$ .

*Infant and Caregiver Engagement Phases (ICEP):* Nash (2013) used the ICEP (Tronick and Weinberg (1999). The ICEP is used to code recorded mother-infant interaction (one code per second). Infant codes are: negative engagement, protest withdrawn, object-environment engagement, social monitor, social positive engagement, sleep, and unscorable. Mother codes are: negative engagement, hostile/intrusive, withdrawn, non-infant focused engagement, social monitor/no vocalizations or neutral vocalizations, social monitor/positive vocalizations, social positive engagement, exaggerated positive engagement, and unscorable. Reliability of the ICEP has been reported using percent agreement for each category of codes – proximity (76-94%), gaze (89%-96%; kappa = 0.79), touch (80-100%; kappa = 0.85), eliciting (77-93%), vocalisation (79-94%). Agreement for elicit codes has ranged between 77% and 96%.

*Maternal Behavior Q-Set (MBQ):* McCullough used the MBQ. MBQ scores have shown significant correlation with the Attachment Behavior Q-set ( $r = .52$ ,  $p < .05$ ; Pederson et al., 1990), and high inter-rater reliability ( $r = .94$ ; Pederson & Moran, 1996).

*Mother-Child Rating Scales (MCRS):* O'Connor, Sigman, and Kasari (1992) used the MCRS (Crawley & Spiker). The MCRS is used to rate recorded child and maternal behaviours. Child rating categories include play maturity, social initiative, and object initiative. Maternal ratings include directiveness, elaborativeness, and sensitivity. No reliability or validity data has been accessible to this author.

*National Institute of Child Health and Human Development (NICHD) network procedure:* Sarfi, Smith, Waal, and Sundet (2011) used the NICHD procedure (NICHD Early Child Care Research Network, 1999) to score 15 minutes of free-play. In the first 7 minutes mothers play with their infants using toys brought from home, and in the final 8 minutes mothers and infants play with a standard toy set. Maternal behaviour is rated in terms of Sensitivity/responsiveness, intrusiveness, detachment, positive regard for the child/positive affect, negative regard for the child/negative affect, animation and stimulation of development. Infant behaviour is rated in terms of positive mood, negative mood, activity and sustained attention. No reliability or validity data has been accessible to this author.

*Nursing Child Assessment Feeding Scale (NCAFS):* Blackwell, Kirkhart, Schmitt, and Kaiser (1998) used the NCAFS to assess quality of mother-interaction during feeding interactions. The scale comprises 76 binary items scored by a trained observer, and can be divided into four maternal subscales (sensitivity to cues, response to distress, social-emotional growth fostering, cognitive growth fostering) and two child subscales (clarity of cues, and responsiveness to parent). Reliability for the total NCAFS has a Cronbach's alpha of .86, and reliability has been found to be similar across ethnic groups (Sumner & Speitz, 1994).

*Nursing Child Assessment Teaching Scale:* Hogan (2002) and Huebner (2002) used the Nursing Child Assessment Teaching Scale (NCATS; Barnard, 1978). The NCATS is completed by a trained observer while the parent teaches the child a standardised task. The NCATS comprises four parent subscales – sensitivity to cues, response to distress, social-emotional growth fostering, and cognitive growth fostering – and two child subscales – clarity of cues and responsiveness to caregiver (Harrison, Magill-Evans, & Sadoway, 2001). Test-retest reliability Cronbach alphas have been reported as 0.85 for the Total Parent score and 0.55 for the Total Child score (Sumner & Spietz, 1994).

*Objective Rating of Infant Behavior Scale (ORIB):* Goldman-Fraser (1997) developed and used the ORIB. The ORIB assesses infant behaviour on three dimensions:



fussiness, soothability, and proportion of negative signals. Each 15-second interval of a 10 minute recorded interaction is coded. Within Goldman-Fraser's (1997) study, inter-rater reliability was  $r = .98$  for the total scale, and  $r = .95$ ,  $r = .98$ , and  $r = .70$  for each respective subscale.

*Parent Caregiving Involvement Scale (P/CIS):* McCullough (1999) used the P/CIS (Farran, Kasari, Comfort, & Jay, 1986) to code maternal behaviour during play with her infant. The P/CIS assesses maternal behaviours in terms of amount, quality, and developmental appropriateness. P/CIS is considered to have conceptual validity (Wilfong, Saylor, & Elksin, 1991). P/CIS reliability has been reported to range from  $r = .77$  to  $r = .87$  in home observations (Farran et al., 1987; Simeonsson, Bailey, Huntington, & Comfort, 1986) and from  $r = .53$  to  $r = .93$  in laboratory settings (Blasco, Hmcir, & Blasco, 1990; Farran, et al., 1987).

*Parental Development Interview Revised:* Pajulo et al. (2012) used the Parental Development Interview Revised (PDI-R) to measure MIR quality. The PDI-R is a semi-structured interview comprising 40 items asking the parent about their perception of their child and relationship with it, and their experience of being a parent, of being parented in their own childhood, what it is like to be separated from the child, and their thoughts about the future (Slade, 2002). Reliability the PDI-R reflective function scale is reported to be significant ( $r = .87$ ), and with the Cronbach's for internal consistency being reported as .90 (Sleed, Slade, 7 Fonagy; 2018).

## Appendix C: Demographic questionnaire

Thinking about your baby – Demographic Information  
Version 2.0 – 27<sup>th</sup> November 2017



### Demographic information

Research project: Thinking about your baby



#### Participant ID:

Please complete the following:

**Please state your age:**

**Please tell us how you view your national identity** (e.g., Scottish, Irish, English, British, Polish etc.):

#### Ethnicity:

Please find and circle the ethnicity that you identify with from the list below:

White: English, Scottish, Welsh, Irish, North Irish, Other

Asian: British, Indian, Pakistani, Bangladeshi, Chinese, Other

Black: British, African, Caribbean, Other

If your ethnicity is not on the list, please state:

#### Education:

Education level	Please tick the option that applies to you
Left school before age 16	
Left school at 16	
Left school at age 17-18	
Completed college course	
Completed university degree	

If your education level is not on the list, please state:

**Employment status:**

Employment status	Please tick all that apply to you
Voluntary work	
Full time employment	
Part time employment	
Unemployed (with benefits)	
Unemployed (without benefits)	
Student	

If your employment status is not on the list, please state:

**Are you a smoker?** (please circle)                      Yes                      No

*If Yes, please indicate how many cigarettes you smoke a day:*

**How many times have you been pregnant?**

**How many times have you given birth?**

**Do you care for your own children at home?** (please circle)                      Yes                      No

**If yes, how many of your own children do you care for at home?**

**Please state the postcode of your current address:**

Thank you 😊

## **Appendix D: Sensitivity Analysis**

Table 1 details the demographic characteristics of the incomplete (n = 91) sample in comparison with the complete (n = 81) sample, in order to assess the acceptability of using data from the complete sample to multiply impute missing data in the incomplete sample. The samples do not differ significantly on mean age, number of weeks' gestation, first-time pregnancies, number of weeks' gestation ethnicity, educational attainment, and employment. Some differences are noted in IMD quintile distribution, with a greater proportion of the n=81 sample residing the first, second, and third IMD quintiles.

Table 2 details the descriptive statistics of the incomplete (n = 91) sample in comparison with the complete (n = 81) sample. The incomplete sample reported lower psychosocial risk, with 19% of respondents scoring 28 or greater on the ANRQ, compared with 32% of the complete sample. History of sexual abuse was slightly higher in the incomplete sample compared with the complete sample (5.5% vs. 4.9%), and history of physical abuse was slightly lower (2.2% vs. 2.5% respectively). Reported alcohol and substance use was similar in each sample. ECR-RS anxiety and avoidance mean scores were very similar between samples. A higher proportion of the complete sample scoring greater than or equal to 12; this is due in part to one item of the EPDS being missing from data returned by the incomplete sample (n = 91). MAAS mean scores were very similar in both samples; as three items were missing from the MAAS data returned by the incomplete group it may be that the incomplete sample would have reported higher mean MAAS scores had data not been missing. Scores on the PCEQ subscales were comparable between samples. We conclude that differences between the two groups are minimal, and that the use of the complete (n = 81) sample to support multiple imputation of missing data in the incomplete (n = 91) sample is acceptable.

**Table 1: Participants' demographic characteristics (incomplete vs complete samples)**

		<i>Incomplete (n = 91)</i>			<i>Complete (n = 81)</i>		
		<b>M</b>	<b>SD</b>	<b>%</b>	<b>M</b>	<b>SD</b>	<b>%</b>
<b>Age (yrs)</b>		30.05	<b>3.94</b>	--	30.11	3.81	--
<b>Gestation</b>		20.81	4.63	--	20.71	4.72	--
<b>Primiparous</b>		--	--	42.9	--	--	44.4
<b>IMD quintile</b>	1 <sup>st</sup> quintile (most deprived)	--	--	16.5	--	--	18.5
	2 <sup>nd</sup> quintile	--	--	11	--	--	12.3
	3 <sup>rd</sup> quintile	--	--	13.2	--	--	14.8
	4 <sup>th</sup> quintile	--	--	18.7	--	--	17.3
	5 <sup>th</sup> quintile	--	--	4.4	--	--	3.7
<b>White ethnicity</b>		--	--	97.8	--	--	97.5
<b>Educational attainment</b>	<i>Undergraduate degree (full or partial completion)</i>	--	--	54.9	--	--	56.8
	<i>Postgraduate degree (full or partial completion)</i>	--	--	3.3	--	--	2.5
	<i>College education/mature student learning</i>	--	--	14.3	--	--	14.8
	<i>Left school aged 17-18 years</i>	--	--	14.3	--	--	13.6
	<i>Left school aged 16 years</i>	--	--	13.2	--	--	12.3
<b>Employment</b>	<i>Any employment</i>	--	--	92.3	--	--	95.1
	<i>Full-time employment</i>	--	--	63.7	--	--	65.4
	<i>Part- time employment</i>	--	--	27.5	--	--	28.4
	<i>Self-employed hour per week not stated)</i>	--	--	1.1	--	--	1.2
	<i>Unemployed with/without benefits/Volunteering/Student</i>	--	--	7.7	--	--	5

**Table 2: Descriptive statistics regarding main outcome measures (incomplete vs. complete)**

	<i>Incomplete (n = 91)</i>			<i>Complete (n = 81)</i>		
	<b>M</b>	<b>SD</b>	<b>%</b>	<b>M</b>	<b>SD</b>	<b>%</b>
<b>ANRQ (psychosocial risk)</b>						
<i>Total ≥ 28 (increased psychosocial risk)</i>	--	--	19	--	--	32
<i>Hx sexual abuse</i>	--	--	5.5	--	--	4.9
<i>Hx physical abuse</i>	--	--	2.2	--	--	2.5
<b>AUDIT (alcohol use)</b>						
<i>TOTAL &gt; 8 (hazardous &amp; harmful use)</i>	--	--	5.5	--	--	6
<b>DAST-10 (drug use)</b>						
<i>Total = 0 (no concern)</i>	--	--	84.6	--	--	86.5
<i>Total = 1 – 2 (low incidence misuse)</i>	--	--	13.2	--	--	11
<i>Total = 3 (intermediate problematic misuse)</i>	--	--	2.2	--	--	2.5
<b>ECR-RS (attachment style) (subscale mean = 4)</b>						
<i>Anxiety</i>	--	--	2.26	2.5	.91	--
<i>Avoidance</i>	--	--	2.56	2.2	1.35	--
<b>EPDS (depression)</b>						
<i>Total ≥ 12 (clinically significant)</i>	--	--	39.5	--	--	57
<b>MAAS (MFR quality) (mean = 57; no cut-off)</b>						
<i>Total</i>	79.36	5.90	--	79.64	5.73	--
<b>PCEQ (caregiving representations)</b>						
<i>Flexible Integration</i>	4.71	.29	--	4.71	.29	--
<i>Deactivation</i>	1.67	.58	--	1.64	.50	--
<i>Cognitive Disconnection</i>	3.24	.70	--	3.23	.72	--
<i>Dysregulation</i>	1.49	.48	--	1.47	.46	--
<i>Constriction</i>	3.89	.54	--	3.9	.53	--
<i>(all subscale means = 3)</i>						

## **Correlations**

Table 3 and Table 4 detail the Spearman's rho correlations between all the main outcome variables conducted on the incomplete ( $n = 91$ ) and complete ( $n = 81$ ) samples respectively. The direction of all correlations in each sample is the same, and the patterns of significance and effect size are highly similar, again indicating that the use of the complete ( $n = 81$ ) sample to support multiple imputation of missing data in the incomplete ( $n = 91$ ) sample is acceptable.

**Table 3: Spearman's rho correlation values (95% CI) main outcome variables, incomplete sample (n = 91)**

	Attachment Avoidance	Attachment Anxiety	Flexible Integration	Deactivation	Cognitive Disconnection	Dysregulation	Constriction	MFR quality	Psychosocial risk
<b>Attachment Anxiety</b>	.572** [.39, .72]	--	--	--	--	--	--	--	--
<b>Flexible Integration</b>	-.127 [-.34, .09]	-.045 [-.25, .162]	--	--	--	--	--	--	--
<b>Deactivation</b>	.132 [-.10, .35]	.180* [-.04, .40]	-.134 [-.35, .09]	--	--	--	--	--	--
<b>Cognitive Disconnection</b>	.079 [-.14, .30]	.151 [-.06, .36]	.063 [-.14, .28]	.027 [-.18, .24]	--	--	--	--	--
<b>Dysregulation</b>	.328** [.13, .51]	.338** [.14, .52]	-.238* [-.43, -.02]	.524** [.33, .70]	.091 [-.12, .29]	--	--	--	--
<b>Constriction</b>	-.215* [-.44, .04]	-.036 [-.25, .20]	.533** [.38, .67]	.030 [-.17, .22]	.257** [.05, .45]	-.098 [-.31, .12]	--	--	--
<b>MFR quality</b>	-.362** [-.54, -.16]	-.353** [-.53, -.17]	.291** [.09, .47]	-.339** [-.53, -.12]	.157 [-.06, .36]	-.517** [-.66, -.34]	.255** [.03, .44]	--	--
<b>Psychosocial risk</b>	.426** [.21, .59]	.442** [.25, .62]	-.120 [-.31, .11]	.101 [-.13, .32]	.247** [.05, .45]	.240* [.01, .43]	-.041 [-.23, .17]	-.305** [-.48, -.11]	--
<b>Depression</b>	.300** [.09, .49]	.426** [.23, .60]	-.180* [-.39, .03]	.228* [.01, .44]	.256** [.07, .46]	.296** [.09, .49]	.038 [-.16, .24]	-.262** [-.45, -.04]	.551** [.36, .71]

(\*p = <.05; \*\*p = <.01)



**Table 4: Spearman's rho correlation values (95% CI) main outcome variables, complete sample (n = 81)**

	Attachment Avoidance	Attachment Anxiety	Flexible Integration	Deactivation	Cognitive Disconnection	Dysregulation	Constriction	MFR quality	Psychosocial risk
<b>Attachment Anxiety</b>	.550** [.38, .71]	--	--	--	--	--	--	--	--
<b>Flexible Integration</b>	-.085 [-.28, .14]	.063 [-.15, .28]	--	--	--	--	--	--	--
<b>Deactivation</b>	.098 [-.13, .32]	.121 [-.11, .35]	-.088 [-.31, .14]	--	--	--	--	--	--
<b>Cognitive Disconnection</b>	.069 [-.17, .31]	.156 [-.08, .36]	.037 [-.18, .26]	.031 [-.20, .27]	--	--	--	--	--
<b>Dysregulation</b>	.297** [.07, .49]	.300** [.07, .51]	-.192* [-.41, .07]	.481** [.29, .66]	.100 [-.13, .31]	--	--	--	--
<b>Constriction</b>	-.238* [-.46, .01]	-.023 [-.25, .19]	.530** [.34, .67]	.016 [-.19, .24]	.201* [-.03, .42]	-.133 [-.35, .10]	--	--	--
<b>MFR quality</b>	-.312** [-.51, -.08]	-.269** [-.47, -.06]	.231* [.02, .43]	-.323** [-.51, -.13]	.175 [-.05, .40]	-.475** [-.63, .26]	.268** [.07, .48]	--	--
<b>Psychosocial risk</b>	.402** [.19, .59]	.419** [.22, .61]	-.105 [-.32, .14]	.107 [-.15, .35]	.200* [-.02, .41]	.249* [.04, .45]	-.119 [-.32, .10]	-.274** [-.46, .07]	--
<b>Depression</b>	.264** [.05, .46]	.390** [.17, .59]	-.178 [-.41, .06]	.198* [-.04, .41]	.207* [-.02, .41]	.262** [.04, .46]	-.042 [-.25, .17]	-.233* [-.45, .00]	.534** [.34, .72]

(\*p = <.05; \*\*p = <.01)

## Appendix E: Original research article tables and figures

**Table 9: Mediation model summary regarding the relationship between attachment avoidance (X), disorganised caregiving representations (M), and MFR quality (Y) (n = 172)**

	R	R-Square	MSE	F	Df1	Df2	p
	.4652	.2164	43.6824	23.3406	2.00	169.00	.0000
	Coefficient	SE	t	p	Lower CI	Upper CI	
Constant	90.5841	1.9523	46.3976	.0000	86.7300	94.4382	
Attachment avoidance	-1.6755	.4803	-3.4883	.0006	-2.6237	-.7273	
Disorganised caregiving representations	-5.4502	1.0849	-5.0236	.0000	-7.5919	-3.3085	

### *Covariance matrix of regression parameter estimates*

	Constant	Attachment avoidance	Disorganised caregiving representations
Constant	3.8116	-.4281	-1.5637
Attachment avoidance	-.4281	.2307	-.1081
Disorganised caregiving representations	-1.5637	-.1081	1.1770

**Table 10: Direct effect of attachment avoidance on disorganised caregiving representations**

Effect	S.E.	t	p	Lower CI	Upper CI
-.0918	.0332	2.7640	.0063	.0262	.1574

**Table 11: Completely standardised indirect effect of attachment avoidance on MFR quality (bootstrapped)**

Effect	Bootstrapped S.E.	Bootstrapped Lower CI	Bootstrapped Upper CI
-.0725	-.0315	-.1408	-.0194

**Table 12: Mediation model summary regarding the relationship between attachment avoidance (X), secure organised caregiving representations (M), and MFR quality (Y) (n = 172)**

	R	R-Square	MSE	F	Df1	Df2	p
	.4634	.2147	43.7765	23.1086	2.0000	169.0000	.0000

**Covariance matrix of regression parameter estimates**

	Constant	Attachment avoidance	Disorganised caregiving representations
Constant	51.9540	-.9839	-10.5216
Attachment avoidance	-.9839	.2246	.0861
Secure organised caregiving represent.	-10.5216	.0861	2.2046


**Table 13: Direct effect of attachment avoidance on secure organised caregiving representations**

Effect	S.E.	t	p	Lower CI	Upper CI
-.0391	.0243	-1.6077	.1097	-.0870	.0089

**Table 14: Completely standardised indirect effect of attachment avoidance on MFR quality (bootstrapped)**

Effect	Bootstrapped S.E.	Bootstrapped Lower CI	Bootstrapped Upper CI
-.0419	.0288	-.1015	.0121

## Appendix F: Evidence of Ethical Approval

<div><p><b>WoSRES</b> West of Scotland Research Ethics Service</p></div> <div></div> <div><p>Ms Imogen Marsh Trainee Clinical Psychologist NHS Lanarkshire Kirklands Hospital Bothwell Lanarkshire G71 8BB</p></div> <div><p>West of Scotland REC 5 West of Scotland Research Ethics Service West Glasgow Ambulatory Care Hospital Dalnair Street Glasgow G3 8SW</p></div> <div><p>Date 13 December 2017</p></div> <div><p>Direct line 0141 232 1804 E-mail WoSRECs@ggc.scot.nhs.uk</p></div> <p>Dear Ms Marsh</p> <p><b>Study title:</b> Thinking About Your Baby - a comparative study of depression, maternal caregiving representations, and maternal-fetal relationship quality in substance misusing and healthy mothers.</p> <p><b>REC reference:</b> 17/WS/0233 <b>IRAS project ID:</b> 231353</p> <p>Thank you for responding to the Committee's request for further information on the above research and submitting revised documentation.</p> <p>The further information was considered in correspondence. A list of the Sub-Committee members is attached.</p> <p>We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact <a href="mailto:hra.studyregistration@nhs.net">hra.studyregistration@nhs.net</a> outlining the reasons for your request.</p> <p><b>Confirmation of ethical opinion</b></p> <p>On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.</p> <p><b>Conditions of the favourable opinion</b></p> <p>The REC favourable opinion is subject to the following conditions being met prior to the start of the study.</p>	<p><u>Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.</u></p> <p>Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).</p> <p>Guidance on applying for NHS permission for research is available in the Integrated Research Application System, <a href="http://www.hra.nhs.uk">www.hra.nhs.uk</a> or at <a href="http://www.rdforum.nhs.uk">http://www.rdforum.nhs.uk</a>.</p> <p>Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&amp;D office on the information it requires to give permission for this activity.</p> <p>For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.</p> <p>Sponsors are not required to notify the Committee of management permissions from host organisations</p> <p><u>Registration of Clinical Trials</u></p> <p>All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).</p> <p>There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.</p> <p>To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.</p> <p>If a sponsor wishes to request a deferral for study registration within the required timeframe, they should contact <a href="mailto:hra.studyregistration@nhs.net">hra.studyregistration@nhs.net</a>. The expectation is that all clinical trials will be registered, however, in exceptional circumstances non registration may be permissible with prior agreement from the HRA. Guidance on where to register is provided on the HRA website.</p> <p>It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).</p> <p><b>Ethical review of research sites</b></p> <p><b>NHS sites</b></p> <p>The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&amp;D office prior to the start of the study (see "Conditions of the favourable opinion" below).</p>
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## Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Copies of advertisement materials for research participants [Project Flyer]	1.0	16 October 2017
Covering letter on headed paper [Covering Letter 051217]	1.0	05 December 2017
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [CT Confirmation]		27 July 2017
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [Employers' Liability]		01 August 2017
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [PI Confirmation]		04 August 2017
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [PL Confirmation]		26 July 2017
GP/consultant information sheets or letters [GP Information Letter]	2.0	29 November 2017
Non-validated questionnaire [Prenatal Caregiving Experiences Questionnaire]		
Non-validated questionnaire [Demographic Questionnaire]	2.0	27 November 2017
Participant consent form [Participant Consent Form]	2.0	27 November 2017
Participant consent form [Online Consent Form]	2.0	27 November 2017
Participant information sheet (PIS) [Participant Information Leaflet]	1.0	16 October 2017
Participant information sheet (PIS) [Participant Information Leaflet NHLSU]	2.0	27 November 2017
Participant information sheet (PIS) [Participant Information Leaflet NHSLC]	2.0	27 November 2017
Participant information sheet (PIS) [Online Participant Information Leaflet]	2.0	27 November 2017
REC Application Form [REC_Form_24102017]		24 October 2017
Research protocol or project proposal [Thinking About Your Baby Study Protocol]	2.0	29 November 2017
Summary CV for Chief Investigator (CI) [Imogen Marsh CV]		20 October 2017
Summary CV for supervisor (student research) [Angus MacBeth CV]		18 September 2017
Validated questionnaire [Antenatal Risk Questionnaire]		
Validated questionnaire [ECR Relationship Structures]		
Validated questionnaire [Edinburgh Postnatal Depression Scale]		
Validated questionnaire [Maternal Antenatal Attachment Scale]		
Validated questionnaire [Alcohol Use Disorders Identification Test Self-Report]		
Validated questionnaire [Drug Use Questionnaire 10]		

## Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

## After ethical review

## Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

## User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website: <http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/>

## HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at <http://www.hra.nhs.uk/hra-training/>

**17/WS/0233 Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project.

Yours sincerely

On behalf of  
Dr Stewart Campbell  
Chair

Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments  
"After ethical review – guidance for researchers" [SL-AR2]

Copy to: Mrs Charlotte Smith, University of Edinburgh  
Mr Raymond Hamill, NHS Lanarkshire

West of Scotland REC 5

Attendance at Sub-Committee of the REC meeting In Correspondence

Committee Members:

Name	Profession	Present	Notes
Dr Stewart Campbell	Consultant Physician & Gastroenterologist (CHAIR)	Yes	
Mrs Naomi Hickey	Research Nurse (Alternate Vice-Chair)	Yes	
Mrs June Russell	Retired (Research Chemist)	Yes	

Also in attendance:

Name	Position (or reason for attending)
Mrs Rose Gallacher	Assistant Co-ordinator

**WoSRES**  
West of Scotland Research Ethics Service



West of Scotland REC 5

West of Scotland Research Ethics Service  
West Glasgow Ambulatory Care Hospital  
Dalmuir Street  
Glasgow  
G3 8BJ

Date 12 December 2018

Direct line 0141 232 1809  
E-mail WoSREC5@ggc.scot.nhs.uk

Ms Imogen Marsh  
Kirklands Hospital  
Bothwell  
Lanarkshire  
G71 8BB

Dear Ms Marsh

**Study title:** Thinking About Your Baby - a comparative study of depression, maternal caregiving representations, and maternal-fetal relationship quality in substance misusing and healthy mothers.

**REC reference:** 17/WS/0233  
**Amendment number:** 4 (AM03)  
**Amendment date:** 22 November 2018  
**IRAS project ID:** 231353

The above amendment was reviewed by the Sub-Committee in correspondence.

**Ethical opinion**

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

**Approved documents**

The documents reviewed and approved at the meeting were:

Document	Version	Date
Notice of Substantial Amendment (non-CTIMP)	4 (AM03)	22 November 2018
Research protocol or project proposal	6.0	22 November 2018

**Membership of the Committee**

The members of the Committee who took part in the review are listed on the attached sheet.

**Working with NHS Care Organisations**

Sponsors should ensure that they notify the R&D office for the relevant NHS care organisation of this amendment in line with the terms detailed in the categorisation email issued by the lead nation for the study.

**Statement of compliance**

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

We are pleased to welcome researchers and R & D staff at our Research Ethics Committee members' training days – see details at <http://www.hra.nhs.uk/hra-training/>

17W3/0233: Please quote this number on all correspondence

Yours sincerely

for  
Dr Stewart Campbell  
Chair

Enclosures: List of names and professions of members who took part in the review

Copy to: Mr Raymond Hamill, NHS Lanarkshire



**West of Scotland REC 5****Attendance at Sub-Committee of the REC meeting****Committee Members:**

Name	Profession	Present	Notes
Dr Stewart Campbell	Consultant Physician & Gastroenterologist (CHAIR)	Yes	
Mrs Naomi Hickey	Research Nurse (Alternate Vice-Chair)	Yes	
Mrs June Russell	Retired (Research Chemist)	Yes	

**Also in attendance:**

Name	Position (or reason for attending)
Mrs Sharon Macgregor	REC Manager

## Appendix G: Study protocol

<p>Version 6.0 22<sup>nd</sup> November 2018</p> <p>IRAS Project ID: 231353</p> <p>Thinking About Your Baby Study Protocol</p> <div></div> <p>Thinking about your baby – A comparative study of depression, maternal caregiving representations, and maternal-fetal relationship quality in substance misusing and healthy mothers.</p> <hr/> <p>Study Protocol Version 6.0</p> <p>Page 1 of 30</p>	<p>Version 6.0 22<sup>nd</sup> November 2018</p> <p>IRAS Project ID: 231353</p> <p>Thinking About Your Baby Study Protocol</p> <p><b>Contacts Page</b></p> <p>Chief investigator (Protocol author): Ms Imogen Marsh Trainee Clinical Psychologist University of Edinburgh/NHS Lanarkshire</p> <p>Academic Supervisor: Dr Angus MacBeth Clinical Psychologist and Lecturer in Clinical Psychology University of Edinburgh</p> <p>Field supervisor: Dr Michelle Cook Consultant Clinical Psychologist NHS Lanarkshire</p> <p>Page 2 of 30</p>
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## Thinking About Your Baby Study Protocol

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## Thinking About Your Baby Study Protocol

## List of abbreviations

<b>ANRQ</b>	Antenatal Risk Questionnaire
<b>AUDIT</b>	Alcohol Use Disorders Identification Test
<b>DAST-10</b>	Drug Use Questionnaire (10 items)
<b>ECR-RS</b>	Experiences in Close Relationships – Relationship Structures
<b>EPDS</b>	Edinburgh Postnatal Depression Scale
<b>ESR</b>	Elevated Psychosocial Risk
<b>MAAS</b>	Maternal Antenatal Attachment Scale
<b>MH</b>	Mental Health
<b>PCEQ</b>	Prenatal Caregiving Experiences Questionnaire
<b>PMHT</b>	Perinatal Mental Health Team
<b>SU</b>	Substance Use/Substance User(s)

## Thinking About Your Baby Study Protocol

## Study synopsis

Title of study	Thinking about your baby – A study of depression, maternal caregiving representations, and maternal-fetal relationship quality in pregnant women.
Study centres	NHS Lanarkshire; University of Edinburgh, School of Health and Social Science.
Duration of study	16 months.
Study end point	The study will end once final data analysis has been completed, which is estimated to be the end of February 2019.
Objectives	To determine whether psychological state is related to quality of maternal-fetal relationship in pregnant women (second trimester) within the general population.
Methodology	Cross-sectional, quantitative design using self-report questionnaires.
Sample size	Minimum sample size of n=100, comprising women in the second trimester of their pregnancy recruited from the general population.  Recruitment of a subsample of women from specialist substance misuse midwifery and perinatal mental health services will continue, with the intention that a small amount of data may be collected to support exploratory statistical modelling to investigate the relationship between substance use and mental health difficulties with the study outcome measures. N=10 high psychosocial risk participants expected to be recruited.
Inclusion criteria	All participants: <ul style="list-style-type: none"> <li>– To be in the second trimester of pregnancy (13 – 28 weeks);</li> <li>– Minimum age 18 years;</li> <li>– Intention to carry pregnancy to term;</li> <li>– Intention to keep infant in own care after birth;</li> <li>– Have literacy skills (in English language) to be capable of completing self-report questionnaires.</li> </ul> <p>Elevated psychosocial risk participants:</p> <p>For substance use group (additional criterion):</p> <ul style="list-style-type: none"> <li>– Be under the care of specialist substance misuse midwifery services.</li> </ul> <p>For PMHT group (additional criterion):</p> <ul style="list-style-type: none"> <li>– Be under the care of a perinatal mental health team.</li> </ul>
Exclusion criteria	All participants: <ul style="list-style-type: none"> <li>– Neurological disorder (historical or current);</li> <li>– Confirmed non-singleton pregnancy.</li> </ul> <p>For healthy control group (additional criterion):</p> <ul style="list-style-type: none"> <li>– Current or historical involvement with specialist services for substance misuse issues;</li> </ul>

## Thinking About Your Baby Study Protocol

	– Complex mental health condition or diagnosis (such as a personality disorder).
Statistical analysis	Correlation analysis. Multiple regression analysis.

## Thinking About Your Baby Study Protocol

**Introduction**

The Scottish Government aims to make Scotland the best place in the world for children to grow up (Scottish Government, 2012). Supporting optimal parent-child relationships and interactions has been identified as one way through which this aim can be achieved (Scottish Government, 2017). High-quality maternal-fetal relationships have been indirectly linked to positive short- and long- term outcomes for children (Walsh, Hepper & Marshall, 2013). In turn, the quality of the maternal-fetal relationship is related to the type of relationship a mother and infant have in the post-natal period (Siddiqui & Hägglöf, 2000). Likewise, the nature of this post-natal relationship predicts the quality of parent-child interaction across childhood, and the lifelong physical, psychological, and social outcomes for the child (Moreira, Gouveia, Carona, Silva & Canavarro, 2015; Siddiqui & Hägglöf, 2000). For example, children and young people who have a positive post-natal relationship with their primary caregiver tend to form a secure attachment style (Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016). A secure attachment style is associated with being less likely to develop mental health problems across the lifespan (Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016).

Supporting women to develop positive maternal-fetal relationships may therefore be a powerful protective process, which may have far-reaching positive consequences for both mother and baby (Walsh, 2010). If the maternal-fetal relationship is viewed as a potential point of early intervention or health promotion for mothers and infants, then it is important to understand what promotes and damages the quality of this relationship. Three factors have already been identified as important: the mother's mental health, the type of life experiences she has had, and her own attachment style (Harder et al., 2015).

Maternal-fetal relationship quality is known to be linked to maternal mental health, although the nature of this relationship is not yet well understood (Walsh et al., 2013). Nevertheless, maternal depression has been significantly linked with poor maternal-fetal relationship in a number of studies (Alhusen, Hayat, & Gross, 2013; Brandon et al., 2008; Lindgren, 2001).

## Thinking About Your Baby Study Protocol

There is a lack of research regarding the link between mothers' life experiences and their relationship with their unborn baby, although some researchers have demonstrated a link between mother's own attachment style and the quality of their relationship with their unborn baby (Alhusen, Hayat, & Gross, 2013). However, there is a significant literature base linking 'adverse childhood experiences' (ACEs) with depression (Chapman et al., 2004), suicidality (Dube et al., 2001, alcohol misuse (Dube et al., 2002), and illicit drug use (Meade, Kershaw, Hansen & Sikkema, 2009). All of these are factors associated with greater risk of insecure or disorganized adult attachment style (Murphy et al., 2014), which we know is related to poorer quality of maternal-fetal relationship (Harder et al., 2015).

Some researchers have suggested that this link between mothers' adult attachment style and the quality of their relationship with their own baby is influenced by the ways mothers think about their baby; these thoughts are referred to as 'caregiving representations' (George & Solomon, 2008). Maternal caregiving representations are defined as the present-moment conceptualisation of a mother's past and current experience of her child, as well as her own memories of attachment experiences, and her current assessment of her relationship with her child (George & Solomon, 2008).

George and Solomon (2008) outline three dimensions of caregiving representations which are associated with the development of organised child attachment styles: flexible integration (secure attachment), deactivation (avoidant attachment), and cognitive disconnection (ambivalent attachment). Two further dimensions of caregiving representations are associated with the development of disorganised child attachment style: punitive control and caregiving constriction (George & Solomon, 2008).

Certain qualities of caregiving representations (such as mothers' ability to understand her baby's view of the world) have been found to influence the relationship between mothers' own negative attachment experiences and their ability to provide sensitive caregiving to their child (Harder et al., 2016). Caregiving representations are therefore potentially useful mechanisms of change which may be harnessed to promote early

## Thinking About Your Baby Study Protocol

positive bonds with the unborn infant, despite previous difficult life experiences and existing adult attachment style (Verhage et al., 2016).

Women with elevated psychosocial risk may be more likely to develop poor maternal-fetal relationships number of reasons (Scobie & Woodman, 2016). Psychosocial risk factors include a history of ACEs (Dube, Anda, Felitti, Edwards, & Croft, 2002), trauma (Reynolds, 2005), insecure attachment style (Thorberg & Lyvers, 2006), and elevated symptoms of psychological distress (Reynolds, 2005), living in poverty (Davies, Nazareth, & Petersen, 2015), lower level of educational attainment (Segrott et al., 2014), and poorer physical health (Mayet, Groshkova, Morgan, McCormack, & Strang, 2008). These socio-economic issues are risk factors for suboptimal outcomes in pregnancy and across a child's lifetime – although their interaction with psychological factors is complex and not yet well understood (Alhusen, Hayat, & Gross, 2013; Petterson, & Albers 2001).

Women with elevated psychosocial risk are therefore more likely to suffer a significant range of psychological and social risk factors for suboptimal outcomes in pregnancy, and their children are vulnerable to a number of negative outcomes across their lifetimes. Specifically, pregnant women with elevated psychosocial risk may be less likely than their healthy peers to have organised caregiving representations regarding their unborn baby, and have less a positive maternal-fetal relationship.

In summary, positive maternal-fetal relationships are linked to greater security in post-natal mother-infant attachment relationships, and secure attachment in childhood is related to positive outcomes across the lifespan. Women with elevated psychosocial risk factors may be particularly vulnerable to developing less organised caregiving representations and less positive maternal-fetal relationships.

## Thinking About Your Baby Study Protocol

**Aims****Primary**

- To determine whether psychological state is related to quality of maternal-fetal relationship in pregnant women (second trimester).

**Secondary**

- To determine whether prenatal caregiving representation quality (avoidance, ambivalence, security, and disorganisation dimensions) is related to quality of maternal antenatal relationship in pregnant women (second trimester).
- To determine whether maternal antenatal risk is related to quality of maternal-fetal relationship in pregnant women (second trimester).
- To determine whether maternal adult attachment style is related to quality of maternal-fetal relationship in pregnant women (second trimester).
- To determine whether maternal psychosocial factors are related to quality of maternal-fetal relationship in pregnant women (second trimester).

**Research questions**

1. Is psychological state (e.g., EPDS score) related to quality of maternal-fetal relationship in pregnant women (second trimester)?
2. Is prenatal caregiving representation quality (avoidance, ambivalence, security, and disorganisation dimensions) related to quality of maternal-fetal relationship in pregnant women (second trimester)?
3. Is maternal antenatal risk related to quality of maternal-fetal relationship in pregnant women (second trimester)?
4. Is maternal adult attachment style (anxious/avoidant) related to quality maternal-fetal relationship in pregnant women (second trimester)?
5. Are maternal psychosocial factors (e.g., educational level, employment status, smoking status, index of social deprivation, age, weeks' gestation) related to quality maternal-fetal relationship in pregnant women (second trimester)?

## Thinking About Your Baby Study Protocol

**Method of investigation***Participants*

All participants will be women in the second trimester of pregnancy (13 to 28 weeks) aged 18 or over. Participants will be recruited from NHS Lanarkshire midwifery services and from across the UK via social media. The study will attempt to recruit a total sample of up to n=250 (comprising a minimum of n=100 from the general population, and a minimum subsample of n=10 women under the care of specialist services for substance use issues and the Perinatal Mental Health Team).

*Inclusion criteria***All participants:**

- To be in the second trimester of pregnancy (13 – 28 weeks);
- Minimum age 18 years;
- Intention to carry pregnancy to term;
- Intention to keep infant in own care after birth;
- Have literacy skills (in English language) to be capable of completing self-report questionnaires.

**For elevated psychosocial risk (EPR) groups:**

Substance use group (additional criterion):

- Be under the care of specialist substance misuse midwifery services;

Perinatal Mental Health Team (PMHT) group (additional criterion):

- Be under the care of a PMHT.

**Exclusion criteria**

All participants:

- Neurological disorder (historical or current);

## Thinking About Your Baby Study Protocol

- Confirmed non-singleton pregnancy.

For healthy control group (additional criterion):

- Current or historical involvement with specialist services for substance misuse issues;
- Complex mental health condition or diagnosis (such as a personality disorder).

### Procedure

#### Informed consent

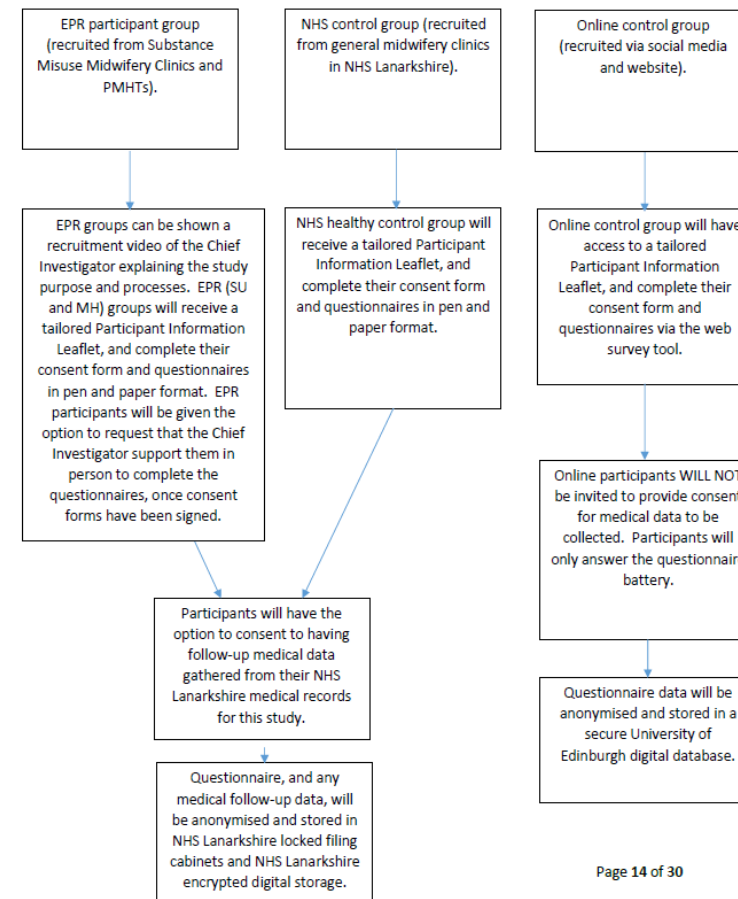
Potential participants have three main routes by which they will be recruited:

- 1) via their care team advertising the study to them and offering them a participant pack (comprising consent form, patient information leaflet, the full battery of study questionnaires, and a debriefing letter). For EPR groups, clinicians will be able to show potential participants a short video of the Chief Investigator explaining the study purpose and processes, to attempt to increase engagement and participant in this group. This video will not replace the Participant Information Leaflet, but rather provide an additional source of information about the study in a more easily accessible format.
- 2) via the Chief Investigator, who will have a 'study stall' at midwifery clinics (both NHS general and speciality midwifery/PMHT services) when possible and where appropriate;
- 3) via the project poster (placed in public locations where potential participants are likely to be, such as general and specialist midwifery clinics, GP practices, libraries, and cafes across the UK and promoted on Facebook and Twitter), which contains the web address for the project website as well as contact details for the researchers. The participants will be able to read all study information, consent to participation, and complete the full questionnaire battery via the study website.

Figure 1 details the flow of data collection and the study materials which support these processes.

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**Figure 1: Flow of data collection and supporting materials used.**



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The participant information leaflets for each group detail: the purpose of the study; what the study would involve; how the results will be disseminated; confidentiality; and steps that can be taken if they experience distress following participation in the study. The participant information leaflets also highlight that involvement in the study will not affect their routine care and management and that they will be free to withdraw their participant from the study at any point during data collection, and will be able to withdraw their data until the 28<sup>th</sup> of February 2019, at which point the study will end. In order to provide participants with information which is relevant only to them, there are some differences between the participant information leaflets given to each group of participants. For example, no information regarding collection of follow-up medical is included in the online participant information leaflet, as this data is not being requested from this group. Information leaflets being given to control participants (both recruited via the NHS and online routes contain a statement regarding the potentially upsetting nature of some questions and potentially perceived irrelevance of some questions regarding substance use). Women recruited from PMHTs will be asked to detail the nature of their mental health issues.

*Data collection*

The participants will be given eight self-report questionnaires. Based on reports in the scientific literature and previous experience within the research team of using the measures, it is estimated that it will take participants 60 minutes will be required to complete the battery of measures and review the participant information leaflet and provide informed consent. Participants will be able to take breaks throughout, at their own discretion (this applies to all participants, including those completing measure online). The participant information leaflet provides signposting for further information and support.

Women within the EPR groups (under the care of specialist substance misuse midwifery services or Perinatal Mental Health Teams) will be allowed to request that the Chief Investigator meet with them to provide support when completing the study questionnaires (e.g., with reading questions aloud, supporting correct interpretation of questions, monitoring potential distress) if necessary. EPR participants will need to have provided written consent to participate in the study before requesting a meeting

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with the Chief Investigator via their main clinical worker. Where possible, meetings will take place at an NHS clinic, or at a home visit accompanied by the participant's main clinical worker. If these options are not possible, the Chief Investigator will conduct a home visit if local risk assessment and lone working policies and procedures permit. The Chief Investigator will only conduct lone home visits where risk assessments have been completed and where risk is deemed to be low or manageable. EPR participants will be made aware of the option to ask for support in completing study questionnaires with the Chief Investigator by an additional flyer in their study packs.

**Measures***Antenatal Risk Questionnaire*

The Antenatal Risk Questionnaire (ANRQ; Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013) is a 12-item questionnaire which can be completed by self-report or as part of a clinical interview. The ANRQ provides a quantitative summary of a woman's level of 'antenatal risk', as related to perinatal mental health problems and sub-optimal parenting interactions (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). Items cover significant mental health history, history of abuse and neglect (physical, sexual, and emotional), current level of social support, support from partner, anxiety and perfectionism, and stressful life events in the past year (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). Participants respond to 12 items on a 0 to 5 Likert scale, with the maximum possible score being 60. A score of 28 is considered the cut-off for 'increased risk'.

When used in conjunction with the Edinburgh Postnatal Depression Scale, the ANRQ is a useful psychosocial assessment tool which supports identification of women at risk of developing postnatal depression (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). Use of the ANRQ has been demonstrated to be highly acceptable amongst pregnant women and clinicians (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013). The ANRQ will be used to assess and report antenatal risk.

*Alcohol Use Disorders Identification Test*



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The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente & Grant, 1993) is a 10-item self-report measure, which enables identification of respondents' hazardous or harmful drinking, or alcohol dependence. The AUDIT gathers information regarding frequency of alcohol consumption, number of alcoholic drinks/units of alcohol consumed, dependence and compulsion to drink, drinking-related injury and amnesia, and emotional response and concerns regarding drinking. Participants rate their responses to AUDIT items on an anchored Likert scale from 0 to 4 (Babor, Higgins-Biddle, Saunders, Monteiro, 2001). A total score of 8 is considered to indicate hazardous and harmful alcohol consumption, and possible dependence (Babor, Higgins-Biddle, Saunders, Monteiro, 2001), although the AUDIT has been shown to be more specific and less sensitive in female samples, and therefore some recommend that the cut-off is lowered to 6 for female populations (Reinert & Allen, 2002). Reinert and Allen (2002) report that the AUDIT is internally consistent across diverse samples and a range of settings; across 18 studies the median Cronbach's alpha was higher than 0.8. The AUDIT has also been shown to have good test-retest reliability (with correlations across time ranging from 0.8 to 0.9), and construct validity (Reinert & Allen, 2002). Whilst there is no specific data assessing the use of the AUDIT in pregnant women, it has been found acceptable for use in female populations, those with complex mental health issues, and those with significant substance use issues. The AUDIT was selected for use in this study because it is considered a valid and reliable measure of alcohol use, and because it provides a significant level of detail about the degree and frequency of alcohol consumption.

*Drug Use Questionnaire 10 item*

The Drug Use Questionnaire 10 item (DAST-10; Skinner, 1982) is a shortened version of the original 28 item measure of problematic substance use – not including alcohol and tobacco (Yudko, Lozhkina & Fouts, 2007). The DAST-10 collects information on respondents' frequency and degree of substance use, including poly-substance use. The DAST-10 also collects information regarding respondents' feelings about their substance use, and the impact of their substance use on their behaviours and relationships with others. All 10 items require a 'yes' or 'no' answer. 'Yes' responses

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are scored 1, 'No' response are scored 0 (with the exception of item 3, which is reverse-scored). The DAST-10 has a cut-off score of 3 (Yudko, Lozhkina, & Fouts, 2007). The DAST-10 is considered to be a valid measure of substance use, having a 0.97 correlation with the DAST-20, and being significantly correlated with other measures of substance use (Yudko, Lozhkina & Fouts, 2007). The DAST-10 has been reported to have internal consistency of between 0.86 and 0.94 (Yudko, Lozhkina & Fouts, 2007), and a test-retest reliability of 0.71 (Yudko, Lozhkina & Fouts, 2007). The DAST-10 was selected for use in this study as it is considered to be a reliable, valid, and internally consistent measure of substance use across a range of populations, including people seeking help for substance use issues, female offenders, and people with psychiatric problems, and its brevity reduces burden on participants completing the questionnaire battery.

*Experiences in Close Relationships – Relationship Structures*

The Experiences in Close Relationships – Relationship Structures questionnaire (ECR-RS; Fraley, Heffernan, Vicary & Brumbaugh, 2011) is a 9 item self-report measure, which assesses attachment style in close relationships. Item responses are recorded on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). Items 1 to 6 measure avoidant attachment style (items 1, 2, 3, and 4 are reverse-scored), and items 7 to 9 measure anxious attachment. Participants' responses for the avoidance and anxiety continua are averaged. There are no cut-off scores.

The ECR-RS composite anxiety and avoidance scores have been found highly reliable, with a Cronbach's alpha of 0.9 (Fraley, Heffernan, Vicary & Brumbaugh, 2011). The ECR-RS was also found to have a factor structure similar to other measures of adult attachment style, indicating that it is a valid measure of adult attachment (Fraley, Heffernan, Vicary & Brumbaugh, 2011).

The ECR-RS measure was selected for its brevity, to reduce burden on participants. This measure also has the advantage of being modifiable, to tap into a more general attachment style construct, rather than restricting participants' answers to items regarding romantic relationships. Fraley (n.d.) has stated that researchers, "...should



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feel free to modify the items [of the ECR-RS] in any way that seems appropriate to you. Many people have modified the items for their research purposes and you should feel free to do the same" Fraley (n.d.). ECR-RS instructions will therefore be adjusted to state "Please answer the following questions regarding important people in your life". This flexibility allows for the likelihood that not all participants will be in a romantic relationship at the time of data collection. In this study, the ECR-RS will be used to assess and report maternal adult attachment style.

*Edinburgh Postnatal Depression Scale*

The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987) is a 10 item self-report measure of depression, with a focus on cognitive symptoms rather than physical (which reduces likelihood of false positive answers due to pregnancy-related physical changes). Responses to each of the 10 items are scored 0, 1, 2, or 3. The maximum score is therefore 30, and a score of 12 or above is likely to indicate depression. EPDS scores have high specificity and sensitivity (95.7% and 81.1% respectively) in mothers (Murray & Carothers, 1990), and has been validated for antenatal as well as postnatal use (Murray & Cox, 1990; Cox & Holden, 2003; O'Connor et al., 2002). The EPDS will be used to assess and report depression in this study, and was selected for its direct applicability to this population and primary research question.

*Maternal Antenatal Attachment Scale*

The Maternal Antenatal Attachment Scale (MAAS; Condon, 1993) is a 19-item self-report measure which assesses 'quality' and 'intensity' of maternal attachment to the fetus on two respective subscales. 'Quality' relates to mother's affect, and 'intensity' to the amount of time she devotes to thinking about and interacting with her fetus. Answers are scored on anchored Likert scales of 1 to 5, with 5 representing high attachment quality and intensity. Some items are reverse-scored. Mean scores can be calculated for both subscales, and a mean global attachment value can also be calculated.

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The MAAS is a valid and reliable measure which provides a score of "global" antenatal attachment, as well as two subscale scores (one measuring "quality" and the other "intensity"). The "quality" score describes the affective experience and the "intensity" score refers to the amount of time the parent spends thinking/dreaming about, interacting with and talking to the fetus. These measures are reported to be reliable and valid, with a Cronbach's  $\alpha$  score of 0.82 (Condon, 1993).

In this study the MAAS will be used to assess and report on maternal-fetal relationship. It was selected because of its validity and reliability of maternal antenatal attachment, and as such is directly applicable to the population sampled in this study.

*Prenatal Caregiving Experiences Questionnaire*

The Prenatal Caregiving Experiences Questionnaire (PCEQ; Brennan, George & Solomon, 2013) is a 40 item self-report questionnaire which requires respondents to rate (on a 5-point scale) their agreement with statements predicting what it will be like to be a caregiver to their baby. The PCEQ measures five types of defensive processing which are associated with patterns of caregiving representation. Three dimensions of organised caregiving representation (flexible integration, deactivation, and cognitive disconnection) are measured by three respective scales. Two further scales assess the (disorganised) dimension of caregiving dysregulation. The five scales are scored separately, with each item response being formed of an anchored Likert scale from 1 ('not characteristic at all') to 5 ('very characteristic') and a mean is obtained for each scale.

The PCEQ is currently being used to assess caregiving representations in a longitudinal cohort study of health and risk transmission between mothers with complex mental health issues and their infants (Harder et al., 2015); use of the PCEQ is being validated in this cohort (Røhder et al. 2015). In this study the PCEQ will be used to assess and report maternal caregiving representations. The PCEQ measure was selected for use in this study as it is the only known quantitative measure of caregiving representations for use in the perinatal period.

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**Demographic data**

The following data will be collected:

- Age;
- Ethnic category;
- Country of origin;
- Educational status;
- Employment status;
- Smoking status;
- First four characters of postcode to convert to Scottish Index of Multiple Deprivation.

This demographic information will be helpful in illuminating the complex relationship between psychosocial risk factors (e.g. substance use), relationship risk factors (e.g., quality and intensity of caregiving representations) and depressive symptoms. Therefore, the data will be used for correlational analyses with the primary and secondary outcome data. It will also allow for assessment of the degree of homogeneity in the overall sample, and the sub-samples of pregnant women with substance use issues, and healthy controls.

**Confidentiality**

Participation in the study will be confidential. However, confidentiality may be breached if a participant is deemed to be of risk to them self or others, and the participant's health care provider can be identified. This will be detailed in the participant briefing sheet.

**Disclosures**

Participants will be made aware before data collection commences (i.e. via the participant information sheet and consent form) that, in cases where their health care

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providers can be identified, confidentiality may be broken in circumstances where they are deemed to be at risk or there is a risk to others. In this instance, the participant would be reminded upon disclosure that the researcher was required to do this and local procedures will then be followed accordingly.

**Data management**

Data will be managed in line with the Data Protection Act (1998), NHS Code of Practice on Protecting Patient Confidentiality (2002), NHS Lanarkshire Information Governance Policies and The University of Edinburgh Data Management Policy. Measures will be collected, scored and anonymised.

Anonymised raw data and participant consent forms collected via NHS based recruitment will be stored in separate locked filing cabinets on NHS premises, only the investigators and NHS staff will have access. Data and analysis will be anonymised; participants will be allocated a code for identification purposes and this alone will be stored with the anonymised research data.

Data collected via online questionnaires will be stored in a secure University of Edinburgh digital database. Data and analysis will be anonymised; participants will be allocated a code for identification purposes and this alone will be stored with the anonymised research data.

Raw data will be disposed in confidential waste within 12 months of completing the data collection phase. Following completion of the study, anonymised data will be stored within the Edinburgh Research Archive for 10 years, following which its storage will be reviewed.

**Data analysis**

Quantitative data analysis will be conducted using SPSS (IBM Corp, 2012). All variables will be checked for normality using the Kolmogorov-Smirnov test.

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*Demographics*

Potential relationships between demographic information and key variables (i.e., depressive symptoms, antenatal psychosocial risk, substance use, and relationship risk indicators) will be explored using t-tests and Pearson correlations. If any non-parametrically distributed data is detected, Spearman rho, Mann-Whitney or Kruskal-Wallis tests will be applied.

*T-test, Chi-Square, & Correlation Analyses*

One-tailed t-test, chi-square, and correlation analyses will be conducted to examine the proposed relationships between psychological state (e.g., greater depressive symptomology), poorer prenatal caregiving representation quality, greater maternal antenatal risk factors and elevated maternal psychosocial risk factors and poorer maternal-fetal relationship quality.

*Multiple Regression Analysis*

Following preliminary analysis, maternal psychosocial risk factors found to be related to quality of maternal-fetal relationship in pregnant women will be entered into a regression model to identify significant predictors of maternal-fetal relationship quality. It is hypothesised that greater incidence of maternal psychosocial and relationship risk indicators will predict the quality of maternal-fetal relationship in pregnant women.

**Risk management***Potential distress*

There is potential of causing distress to participants when prompting them to reflect on difficult life experiences, substance use, the quality of their relationships with other people, and how they feel about their unborn baby. Participants will receive a participant information leaflet, and informed consent will be a requirement for the individual to participate in the study. Participants will be able to withdraw from participant in the study at any point during data collection, and will be able to withdraw

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their data up until 31/03/18, at which point the study ends and the Chief Investigator will no longer be able to trace the data back to an individual. In the event that participation in the study highlights existing psychological needs for that participant, and the participant is identifiable and contactable, the research team will signpost the participant to appropriate existing mental health support, as per health board policy. In addition, as per the arrangements for participant confidentiality, under duty of care, the primary investigator will flag the above concerns to the individual's midwife, if this information is available to the researcher. This mechanism will be highlighted in the participant information leaflet.

*Data protection and confidentiality*

Participation in the study will be confidential. However, confidentiality may be breached if a participant is deemed to be of risk to themselves or others. Participants will be made aware of this prior to participating in the study via the participant information leaflet and the consent form. Upon a concern arising that is deemed necessary to report, the Chief Investigator would initially remind the participant of the researcher's obligations to report concerns and seek to obtain consent from the participant to do so. Where possible, if the participant does not consent to the concern being reported, the Chief Investigator will report her concerns to the identified healthcare provider, who will be part of their antenatal care-team. This procedure adheres with Section 1.2 of the British Psychological Society's Code of Ethics and Conduct (Oates, Kwiatkowski, Morrison Coulthard, 2009). Anonymised raw data, participant consent forms, and the document linking the two will be stored in separate locked filing cabinets to which only the Chief Investigator will have access.

*Confidentiality*

Participation in the study will be confidential. However, in cases where participants' health care providers can be identified, confidentiality may be breached if a participant is deemed to be of risk to them self or others. This will be detailed in the participant information leaflet.

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*Disclosures*

Participants will be made aware before data collection commences (i.e. via the participant information leaflet and consent form) that confidentiality may be broken in circumstances where they are deemed to be at risk or there is a risk to others, and their health care provider can be identified. In this instance, the participant will be reminded upon disclosure that the researcher was required to do this, and local procedures will then be followed accordingly.

**Dissemination**

The research will be written up in part fulfilment of the Doctorate in Clinical Psychology as well as being submitted to a peer-reviewed journal. Results will also be disseminated via the study website; participants and care team members who helped to advertise the study will have been provided with the web address.

**Anticipated benefits of the study**

This study aims determine whether psychosocial risk factors experienced by pregnant women are related to, or indeed predict, quality of maternal-fetal relationship. The study will therefore add to the literature regarding understanding of social and mental health risk factors in pregnancy.

This study is believed to be the first of its kind to examine the potential relationships between these risk factors, and therefore will add to the literature base literature in the field of perinatal psychology. This study is expected to identify specific avenues of enquiry for future research.

In addition, although perinatal mental health have been identified as priorities for service development and investment in Scotland (Scottish Government, 2017a), the findings from the proposed project has the potential to inform and improve both perinatal mental health and parenting support services in Scotland.

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**Study timetable**

Stage	Time period
Submit amendments to study	As required
Data collection	February 2018 onwards
Data analysis	January and February 2019
Write up	November 2018 to end February 2019

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